Ana Margarida Cruz da Silva

Mestre em Engenharia de Materiais

History, materials and techniques of an artist's book: *La Légende de Saint Julien l'Hospitalier* by Amadeo de Souza-Cardoso

Dissertação para obtenção do Grau de Doutor em
Conservação e Restauro do Património

Orientador: Doutora Maria João Seixas de Melo, Professora Catedrática, FCT-UNL
Co-orientadores: Doutora Márcia Gomes Vilarigues, Professora Auxiliar, FCT-UNL
Co-orientador: Doutor Marcello Picollo, Investigador Principal, IFAC-CNR, Florença

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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

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Março 2017

Dedicated to my family
and to my friend Alina.

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Abstract

Amadeo de Souza-Cardoso (1887-1918) is considered the most notorious artist of Portuguese modernism. In 1912, he created the manuscript *La Légende de Saint Julien l'Hospitalier*, copying and illustrating the homonymous tale by Gustave Flaubert (1821-1880). Within an interdisciplinary project, this dissertation reports the characterisation of Amadeo's early career in what regards its history, materials and techniques and for the purpose, *La Légende* was selected as case study. The organization of this work involved the differentiation of three parts. The first part regards an Art History perspective on this artwork, where are presented the results that allow defining *La Légende* as an artist's book and the manuscript's placement among the universe of the Portuguese and international artist's books until 1912. Many peculiarities of this book and the dialogue between modernist and medievalist sources that inspired Amadeo in the creation of this "modernist codex" are also discussed. The second part is devoted to the study of the materials and techniques used in the conception of *La Légende*. The construction and state of conservation of this artist's book are analysed. Visual examination methods such as observation by means of optical microscopy and transmitted light contributed for a better understanding of the bookbinding, the text block and the general state of conservation of the manuscript. Silver painted areas oxidation and the yellowing of fly-leaves and guards are the most significant conservation problems found in *La Légende*. Amadeo's creative process was also studied at a macro and micro level. With the collaboration of four professional illustrators, the artist's drawing technique was analysed. The pictorial palette employed by Souza-Cardoso in this work was investigated following an *in situ* approach by means of UV-Vis-NIR Fibre Optic Reflectance Spectroscopy (FORS), Raman microscopy (μ-Raman) and μ-Energy-Dispersive X-Ray Fluorescence Spectroscopy (μ-EDXRF). The obtained results for *La Légende*'s palette are in accordance with previous studies regarding Amadeo's materials and techniques with the exception of chrome yellow and cerulean blue that are absent. The identification of the binding medium was performed by combining FORS with Principal Component Analysis (PCA) and tentatively, the result suggests the presence of Arabic gum in Amadeo's colours and thus, the use of watercolour technique. The identification of the pictorial palette was useful to the colour mapping of the manuscript using mathematical algorithms. The results obtained propose an interpretation of the use of the colours by the artist and how they collaborate in the comprehension of Flaubert's tale. Finally, the study of the materials and techniques of *La Légende* provided the establishment of adequate preventive conservation guidelines for the museum where the manuscript is kept in custody. Finally, the third part of the dissertation concerns the creation of a library of UV-Vis-NIR reflectance spectra of modern watercolour paints. This tool was applied during the characterisation with FORS of the pictorial materials used by Amadeo de Souza-Cardoso in *La Légende de Saint Julien l'Hospitalier*. It is available to scientific community through the website: http://mowcres.ifac.cnr.it.

Keywords: Amadeo de Souza-Cardoso; artist's book; *in situ* analytical techniques; FORS; watercolours.

Resumo

Amadeo de Souza-Cardoso (1887-1918) é considerado o mais importante artista modernista português. Em 1912, Amadeo criou o manuscrito *La Légende de Saint Julien l'Hospitalier*, copiando e ilustrando o conto homónimo de Gustave Flaubert (1821-1880). No âmbito de um projecto interdisciplinar, esta dissertação visa caracterizar o início da carreira de Amadeo no que concerne à história, materiais e técnicas. Para tal, a obra *La Légende* foi seleccionada como caso de estudo. A organização do trabalho implicou a distinção entre três partes. A primeira parte refere-se a uma prespectiva da História da Arte, onde são expostos os resultados que levam a definir o manuscrito de Amadeo como livro de artista e o posicionamento deste no universo dos livros de artista portugueses e estrangeiros produzidos até 1912. Serão ainda discutidas muitas peculiaridades existentes neste livro e o diálogo estabelecido entre fontes modernistas e medievais e que terão inspirado Amadeo na criação deste "códice modernista". A segunda parte é dedicada ao estudo dos materiais e técnicas usados pelo artista na concepção da *La Légende*. A construção e estado de conservação deste livro de artista são analisados. Métodos de exame visual como a observação por microscopia óptica e por luz transmitida contribuíram para uma melhor compreensão da encadernação, corpo de texto e o estado geral de conservação do manuscrito. Os principais problemas de conservação observados na obra são a oxidação das áreas pintadas a prata e o amarelecimento das guardas e carcelas. O processo creativo de Amadeo foi também estudado tanto ao nível macro como microscópico. A sua técnica de desenho foi analisada em colaboração com quatro ilustradores profissionais. A paleta pictórica usada pelo artista foi identificada através de uma abordagem *in situ* por meio de técnicas de caracterização analítica: espectroscopia em reflectância por fibras ópticas (FORS) no UV-Vis-NIR, micro-espectroscopia Raman (μ-Raman) e micro-fluorescência de raios-X dispersiva de energias (μ-EDXRF). Os resultados obtidos no que se refere à paleta usada nesta obra são coerentes com estudos anteriores relativos aos materiais e técnicas de Amadeo, estando apenas ausentes o amarelo de crómio e o azul cerúleo. A identificação do ligante foi realizada mediante a combinação da informação espectral FORS com Análise de Componentes Principais (PCA). Os resultados obtidos parecem sugerir a presença de goma arábica nas tintas do artista e, consequentemente, da aplicação da técnica de aguarela. A identificação da paleta pictórica contribuiu para a realização de um estudo baseado no mapeamento da cor no manuscrito usando algorítmos matemáticos. Os resultados sugerem uma interpretação para a aplicação das cores por parte do artista e como estas contribuem para a compreensão do conto de Flaubert. O estudo dos materiais e técnicas da *La Légende* culminou com o estabelecimento de directrizes adequadas de conservação preventiva a fornecer ao museu, a cuja colecção pertence esta obra. Por último, a terceira parte da dissertação refere-se à criação de uma biblioteca espectral UV-Vis-NIR em reflectância de aguarelas modernas. Este passo foi essencial para a caracterização por FORS dos materiais usados por Amadeo de Souza-Cardoso na *La Légende de Saint Julien l'Hospitalier*. Esta base de dados espectral está disponível através do sítio na Internet: http://mowcres.ifac.cnr.it.

Termos-chave: Amadeo de Souza-Cardoso; livro de artista; técnicas analíticas *in situ*; FORS; aguarelas.

Sommario

Amadeo de Souza-Cardoso (1887-1918) è considerato il più importante artista del Modernismo portoghese. Rientra tra le sue opere il manoscritto *La Légende de Saint Julien l'Hospitalier* (1912), nel quale copiò e illustrò l'omonimo racconto di Gustave Flaubert (1821-1880). All' interno di un più ampio progetto interdisciplinare, questa tesi è focalizzata alla caratterizzazione della prima fase di produzione artistica di Amadeo: la storia, le tecniche e i materiali da lui impiegati. In questo contesto, *La Légende* è stato scelto come caso studio in quanto considerato rappresentativo della sua produzione artistica. Il presente lavoro è stato suddiviso in tre parti principali. La prima argomenta il contesto storico e artistico in cui si inserisce il manoscritto presentando i risultati ottenuti, che permettono l'identificazione dell'opera come libro d'artista e il suo collocamento all'interno del contesto portoghese e ambiente internazionale fino al 1912. In questa parte vengono anche considerate le differenti caratteristiche di questo libro, tra cui il dialogo tra il linguaggio modernista e medioevale che ispirò Amadeo nella realizzazione di questo "codice modernista". La seconda parte è incentrata sullo studio dei materiali e tecniche utilizzate nella realizzazione di *La Légende*. Qui viene discusso lo stato di conservazione dell'opera descrivendo i principali fenomeni di degrado. L'esame visivo, mediante l'impiego della microscopia ottica e della transilluminazione, ha contributo alla comprensione della rilegatura del libro, della fermatura delle carte e nella generale valutazione dello stato di conservazione. I più significativi segni di alterazione riscontrati sono da riferirsi all'ossidazione delle aree dipinte in cui è presente argento e all'ingiallimento delle carte di guardia e brachette nella rilegatura. Il processo artistico creativo di Amadeo è stato inoltre studiato sia a un livello micro che macro al fine di comprenderne la tecnica di disegno; quattro illustratori professionisti hanno contribuito in questo progetto di studio. La tavolozza pittorica è stata analizzata *in situ* mediante spettroscopia di riflettanza tramite l'uso di fibre ottiche (FORS) nell'UV-Vis-NIR, spettroscopia Raman (μ-Raman) e spettroscopia di fluorescenza a raggi X con dispersione energetica (μ-EDXRF). I risultati ottenuti sono coerenti e in accordo con studi precedenti sui materiali e tecniche utilizzate da Amadeo. Unica eccezione è rappresentata dall'assenza dei pigmenti giallo di cromo e blu ceruleo. Per quanto concerne l'identificazione del legante utilizzato dall'artista sono stati utilizzati dati FORS per uno studio multivariato mediante analisi delle componenti principali (PCA): i risultati così ottenuti hanno suggerito l'impiego di colori ad acquarello data la possibile presenza di gomma arabica. Mediante l'identificazione della tavolozza pittorica, è stato possibile mappare la distribuzione dei pigmenti riscontrati tramite algoritmi matematici. Sulla base dei risultati ottenuti, viene presentata una potenziale interpretazione dell'impiego dei colori da parte di Amadeo e la sua personale comprensione del racconto di Flaubert. Infine, sono state riportate nuove raccomandazioni al fine della conservazione del manoscritto sulla base dei materiali e tecniche artistiche identificate. La terza parte della presente tesi è incentrata sulla presentazione di un database di spettri UV-Vis-NIR in riflettanza di colori moderni ad acquarello. In questo progetto, l'archivio spettrale creato ad hoc è risultato essenziale al fine della caratterizzazione dei materiali pittorici utilizzati da Amadeo nella realizzazione di *La Légende de Saint Julien l'Hospitalier* tramite FORS. Questo database è disponibile online al sito: http://mowcres.ifac.cnr.it.

Termini-chiave: Amadeo de Souza-Cardoso; libro d'artista; tecniche analitiche *in situ*; FORS; acquerelli.

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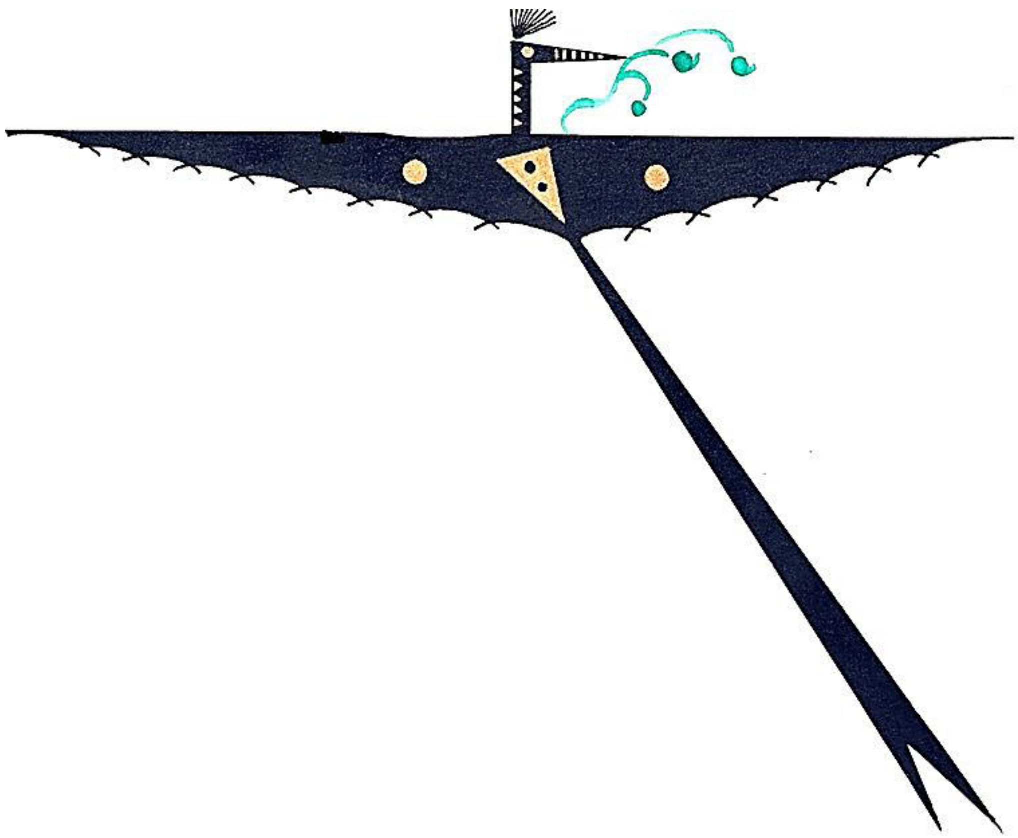
Abbreviations and symbols

ΔG^o	Standard Free Energy Change
ΔH_f	Enthalpy of formation
ε	Absorption coefficient
ϕ	Angle
λ	Wavelenght
ν	Frequency
μ-EDXRF	Micro-Energy-Dispersive X-Ray Fluorescence Spectroscopy
μ-Raman	Raman microscopy
A	Absorbance
A′	Apparent absorbance
AA. VV.	Various authors
adapt.	Adaptation
ads	Adsorbed
AIC	American Institute of Conservation
Alc.	Alcobaça manuscript
ASC	Amadeo de Souza-Cardoso
BA-FCG	*Biblioteca d'Arte* – *Fundação Calouste Gulbenkian*
BL	British Library
BMR	*Bibliothèque Municipale de Reims*
BNF	*Bibliothèque Nationale de France*
BNP	*Biblioteca Nacional de Portugal*
BPMP	*Biblioteca Pública Municipal do Porto*
c	velocity of propagation of a monochromatic wave in vacuum
c	concentration (Lambert-Beer equation)
c.	*circa*
ca.	*circa*
CCI	Canadian Conservation Institute
Cf.	*confer*
C.I.	Colour Index
DCR-FCT-UNL	Department of Conservation and Restoration from *Faculdade de Ciências e Tecnologia–-Universidade Nova de Lisboa*
DGARQ-ANTT	*Direcção-Geral de Arquivos–Arquivo Nacional Torre do Tombo*
DMS	Dimethyl sulphide
DRS	Spectrophotometer of diffuse reflectance
E	Energy
E^0	Standard electrode potential
E_g	Energy gap
ed.	Edition
e.g.	*exempli gratia*
e.m.	Electromagnetic
$F(R_\infty)$	Kubelka-Munk function
FCG	*Fundação Calouste Gulbenkian*
FCSH-UNL	*Faculdade de Ciências Sociais e Humanas–Universidade Nova de Lisboa*
FCT	*Fundação para a Ciência e Tecnologia–Ministério da Educação e da Ciência*
FCT-UNL	*Faculdade de Ciências e Tecnologia–Universidade Nova de Lisboa*
FCUL	*Faculdade de Ciências da Universidade de Lisboa*
fl.	*Folio*
FLUP	*Faculdade de Letras da Universidade do Porto*
FORS	Fibre Optic Reflectance Spectroscopy
FTIR	Fourier transform infrared spectroscopy
Gn.	Genesis

h	Planck constant
HOMO	Highest occupied molecular orbital
I_0	Intensity of the monochromatic incident light that interacts with the sample
I	Intensity of light emerging from the sample after absorption
I	Incident light flux (KM theory)
ICOM-CC	International Council of Museums Committee for Conservation
i.e.	*id est*
IFAC-CNR	*Istituto di Fisica Applicata "Nello Carrara"*
IHA	*Instituto de História da Arte*
IL	Medieval illuminated manuscript
IR	Infrared
J	Scattered light flux (KM theory)
K	Absorption coefficient (KM theory)
KM	Kubelka-Munk
K_{sp}	Solubility product constant
lit.	Literaly
LO	Longitudinal optical
LUMO	Lowest unoccupied molecular orbital
MG-FC	*Museu Gulbenkian* – Founder Collection
MG-MC	*Museu Gulbenkian* – Modern Collection
MoMA	The Museum of Modern Art, New York
MS.	Manuscript
n	Refractive index
n.d.	No date
p.	Page
PCA	Principal component analysis
PNM	*Palácio Nacional de Mafra*
ppb	Parts per billion
ppt	Parts per trillion
r	Retro (folio)
R	Specular reflectance
RH	Relative humidity
RNM	Réunion des musées nationaux
R_∞	Reflectance power (KM theory)
S	Scattering coefficient (KM theory)
s.n.	*Sine nomine*
T	Period
T	Transmittance
T	Temperature
trans.	Translation
UV	Ultraviolet
UV-Vis-NIR	Ultraviolet-Visible-Near Infrared
v	Verso (folio)
Vis	Visible
W&N	Winsor & Newton
w/v	weight/volume



Accomplir c'est vaincre[1]

[1]Amadeo de Souza-Cardoso's motto at the beginning of his career.

[Amadeo de Souza-Cardoso] is the first Discovery of Portugal in the 20^{th} century Europe.

José de Almada Negreiros, 1916[2]

GENERAL INTRODUCTION

a) Background

> *And so away he goes, hurrying, searching. But searching for what? Be very sure that this man, such as I have depicted him – this solitary gifted with an active imagination, ceaselessly journeying across the great human desert – has an aim loftier than that of a mere 'flâneur', an aim more general – something other than the fugitive pleasure of circumstance. He is looking for that quality which you must allow me to call 'modernity'* [Baudelaire 1993, 21].

These words by Charles Baudelaire (1821-1867) from *The Painter of Modern Life* seem to perfectly depict the Portuguese painter Amadeo de Souza-Cardoso (Manhufe, 1887- Espinho, 1918).

Authors that studied Amadeo's oeuvre consider his name as the most brilliant from the generation of Portuguese modernist painters of the first half of the 20^{th} century [Macedo 1960, 35; Ferreira 1995, 9; Gonçalves 2008, 99]. Quoting the art historian Helena de Freitas, *between Manhufe and Paris, he developed the most significant possibility of Portuguese modern art* [Freitas 2008, 17].

In Portugal, the terms "modern art" and "modernism"[3], in the artistic field, allude to the period between 1910s and 1940s of the last century [França 2004, 9]. The art historian and critic Rui-Mário Gonçalves refers that, 1912 was the year when the work of a few young Portuguese artists – most of them, *having cultural lessons abroad which turned into individual behaviour*. Among these artists were Amadeo, the composer Luís de Freitas Branco (1890-1955), the poets Fernando Pessoa (1888--1935) and Mário de Sá-Carneiro (1890-1916), the painters Eduardo Viana (1881-1967), Guilherme de Santa-Rita (1889-1918) and José de Almada Negreiros (1893-1970)[4] [Gonçalves 2011, 90].

Being part of the so-called *École de Paris*, Amadeo was aware of the changes that were occurring in the artistic panorama at the time. These changes were result of scientific and technical innovations

[2] From his *Manifesto for the Exhibition of Amadeo de Souza-Cardoso* in Lisbon, in 1916 [Negreiros 1916] (Translation by the author of this dissertation).

[3] According to Dix and Pizarro: *Modernism understood as a critical category associated with the initial impulse of avant--gardist experimentation, a profound concern to renew all artistic forms in every aspect, and a permanent search for alternative systems of beliefs and values* [Dix and Pizarro 2011, 2].

[4] Freitas Branco has been in Germany; Pessoa lived in South Africa and imbibed the British culture. Mário de Sá-Carneiro, Santa-Rita and Viana, as Amadeo, were living in Paris in that period [Gonçalves 2011, 91]. The *entrée* to modernism occurred to Eduardo Viana in 1911 with the participation in the *Exposição Livre* [França 2011, 171]; the following year, Santa-Rita remained interested in Futurism after visiting the famous exhibition held in Paris [Gonçalves 2011, 90]; in 1912, Almada showed works in the *I Salão dos Humoristas Portugueses*; between 1911-1912, Amadeo published the album *XX Dessins* and started participating in the exhibitions at the Parisian Salons [França 2011, 171].

happening in the world since the Industrial Revolution (between 18th and 19th centuries) and contributed for the modernity and innovative character of Amadeo's work [França 2011, 171; Meecham and Sheldon 2013, 32]. His artworks mirror his thought that technique was no longer important but what really mattered was the innovation; in other words, modernity[5]. As stated by the artist: *- I don't follow any school. Schools are dead. We, the young, we just seek originality. Am I an impressionist, a cubist, a futurist, an abstractionist? A bit of everything*[6]. As referred by the art historian Catarina Alfaro, the reflection over iconographic and aesthetic paradigms of his time and the need for a constant plastic experimentation beyond these artistic movements are characteristic in Amadeo's artistic individuality [Alfaro 2010, 15]. The artist and writer Cornel Bierens uses an interesting metaphor comparing the movement of Souza-Cardoso's work with one of those fair rides which spin around on discs which in the meantime spin around larger discs. Amadeo de Souza-Cardoso's career was short but intense[7] – about one decade – and a question remains: how would it have developed if the artist had lived longer [Bierens 2001, 124]?

The importance of Amadeo's work in the Portuguese artistic panorama was early accredited by some of his compatriots as Almada Negreiros, who became a close companion. In 1969, in Amarante, on the occasion of the 50th anniversary of the death of Amadeo de Souza-Cardoso, Almada uttered the following words: *He brought [to Portugal] the call that he had received in Paris. Not from France. Not from the whole world, but from Humanity* [Cardoso 1998, 137].

Amadeo's works were recognised by non-Portuguese critics and artists such as Modigliani, Brancusi, Delaunay, Freundlich, Gris, Gaudier-Brzeska, Boccioni, Severini, Archipenko, Apollinaire, Walter Pach, Louis de Vauxcelles and others, as will be further presented [Freitas 2007, 15; Gonçalves 2011, 98].

By contrast, in Portugal, in what concerns the visual arts, during the first two decades of the 20th century, the artistic taste was, mainly, engaged to the academic production with roots of Naturalism [Machado and Soares 2016, 115]. In fact, as noted by José-Augusto França and Rui-Mário Gonçalves who have studied Amadeo's oeuvre, the painters nationally acclaimed at the time were the naturalist Columbano Bordallo Pinheiro (1857-1929) and José Malhoa (1885-1933) [França 2011, 172; Gonçalves 2011, 95]. These canons have long been past in the rest of Europe [Pinto de Almeida 2008]. Thus, with the premature death of Souza-Cardoso at the age of 30 and this artistic panorama in his country, a long silence of about forty years, fell on his oeuvre. In 1953, a room dedicated to the artist was created at *Museu de Amarante*. In 1956, José-Augusto França presented the first study on Amadeo. The *Secretariado de Propaganda Nacional/ Secretariado Nacional de Informação* (SPN/SNI) promoted the first retrospective exhibition in Portugal in 1958-1959. These were some of the first steps given towards the recognition of the artist as a pioneer of modernism in Portugal [França 1956; Pinharanda 2009; Alfaro 2010, 7].

[5]Cf. Dix and Pizarro 2011, 2.
[6]From the interview that Amadeo de Souza-Cardoso gave to the newspaper *O Dia* in 1916 [BA-FCG (ASC 31/22] (Translation by the author of this dissertation).
[7]In a period of about fourteen years, Amadeo de Souza-Cardoso produced *circa* 550 pieces [Alfaro 2010, 7].

The sense of justice that the memory of the painter demands is an issue that the *Fundação Calouste Gulbenkian* (FCG) in Lisbon has been working in order to gain the artist's recognition internationally. As a matter of fact, this Foundation owns the most significant number of pieces of Amadeo de Souza-Cardoso, most of them donated by Lucie de Souza-Cardoso, Amadeo's widow, in 1987. They are conserved at the *Museu Gulbenkian –* Modern Collection (MG-MC) which was inaugurated on July 26, 1983 with the exhibition *Amadeo de Souza-Cardoso, o pioneiro da arte moderna portuguesa* [Amadeo de Souza--Cardoso, the pioneer of Portuguese modern art] [Gouveia 2007, 11; Silva 2016, 13]. Moreover, the *Biblioteca d'Arte* of the Foundation (BA-FCG) possesses the estate of the artist also donated by Lucie [Freitas 2007, 14; Barata 2012, 44]. It is composed of photographs, press-cutting, monographs, periodicals and other objects[8].

Amadeo's talent was celebrated in an important exhibition carried out by FCG in 2006. It was entitled *Diálogo the Vanguardas* [*Avant-Garde* Dialogues] and was curated by Helena de Freitas[9]. In this exhibition Amadeo's oeuvre was confronted with pieces from his foreign contemporaries. This parallelism was crucial for a better understanding of the importance and singularity of his works in the international panorama. On the occasion, a *facsimile* edition of Amadeo's illustration of *La Légende de Saint Julien l'Hospitalier*[10] written by Gustave Flaubert was published with the aim of making known a less known work of the artist [Vilar 2006, 9; Gouveia 2007, 11]. Another action by FCG was the publication of two of the three volumes of the most recent Catalogue *Raisonné* on Amadeo de Souza-Cardoso. This work was also coordinated by Helena de Freitas. Volume I was published in 2007 and present a Photobiography elaborated by Catarina Alfaro, based on the documents available in the estate of the artist at BA-FCG and from other relevant sources, as the artist's family's estate [Alfaro 2007; Alfaro 2010, 7]. It presents an update of Amadeo's bibliographic data [Gouveia 2007, 11]. Volume II, published in 2008, is dedicated to his paintings, described chronologically. The two volumes together offer a better contextualization and understanding of the artist's oeuvre. Finally, Volume III has not yet been published but it will concern the drawings of the Portuguese artist.

In the second volume of the Catalogue *Raisonné*, a section is dedicated to the first scientific investigation on the materials and techniques published on Amadeo' paintings. It was performed by a group from the Department of Conservation and Restoration from *Faculdade de Ciências e Tecnologia–-Universidade Nova de Lisboa* (DCR-FCT-UNL), led by Maria João Melo and Márcia Vilarigues. As referred by these authors, the knowledge of the materials and techniques leads to a better understanding and enjoyment of the artist's work and it also allows to imagine him *in the making* [Vilarigues *et al.* 2008, 81]. Moreover, the knowledge of the pictorial palette used by the artist is a crucial tool for the authentication of

[8]Further information at: http://www.biblartepac.gulbenkian.pt/ (Last accessed on February 11, 2017).

[9]Recently, an important exhibition on Amadeo, also curated by Helena de Freitas, was hosted at the *Grand Palais-Champs Elysées* in Paris in the occasion of the 60th anniversary of FCG (between April -July 2016). Another two exhibitions, curated by Raquel Henriques da Silva and Marta Soares, were held at the *Museu Soares dos Reis* in Porto (between November-December 2016) and at the *Museu Nacional de Arte Contemporânea-Museu do Chiado* in Lisbon (between January-February 2017).

[10]The facsimile edition was published in two versions (deluxe and normal).

his works. In the referred study, 23 paintings (1913-1916) from the collection of MG-MC were analysed and it concluded that the pigments and materials used by Amadeo de Souza-Cardoso reveal the taste of a modern artist showing a main predilection for colours from the Chemistry of his time. The palette identified is composed by *a handful of colours* of good quality. The main pigments identified were: Prussian blue ($Fe_4[Fe(CN)_6]_3 \cdot 14H_2O$ or $KFe[Fe(CN)_6] \cdot H_2O$), cobalt blue ($CoO \cdot Al_2O_3$), cerulean blue ($CoO \cdot nSnO_2$), ultramarine blue ($Na_{8-10}Al_6Si_6O_{24}S_{2-4}$), viridian ($Cr_2O_3 \cdot 2H_2O$), emerald green [$Cu(C_2H_3O_2)_2 \cdot 3Cu(AsO_2)_2$], vermilion (HgS), chrome yellow ($PbCrO_4$), cadmium yellow (CdS), yellow ochre (α-FeO(OH) goethite), lead white ($2PbCO_3 \cdot Pb(OH)_2$), barium sulphate ($BaSO_4$) and carmine [Vilarigues *et al.* 2008, 91].

The know-how acquired from the research for the Catalogue *Raisonné* was applied to the creation of the project *Crossing borders: History, materials and techniques of Portuguese painters from 1850-1918*, developed by DCR-FCT-UNL with the prospective not only to continue going further in the study and making known of Amadeo's oeuvre (modernism), but also to open the spectrum to the study of artists from the romanticism and naturalism periods. In this interdisciplinary project, art historians, curators, conservation scientists and informatics scientists collaborated for a better characterisation of these three artistic movements (romanticism, naturalism and modernism) in Portugal. The practices of these Portuguese artists were analysed comparatively to those of their European contemporaries, to prospect them in a historical and social context. The investigation was carried out in collaboration with three museums from Lisbon: MG-MC, *Casa-Museu Anastácio Gonçalves* and *Museu Nacional de Arte Contemporânea – Museu do Chiado*. The project was financed by *Fundação para a Ciência e Tecnologia – Ministério da Educação e da Ciência de Portugal* (FCT) (PTDT/EAT-EAT/113612/2009) from January 1, 2011 until September 30, 2014 and seven PhD students[11] have been working on it.

The main objectives *Crossing Borders* had in mind were the analysis at the molecular level of the paints used by these artists in view of developing adequate strategies of conservation and restoration, and the computational analysis of the brushstroke.

As consequence of the previous investigation for the Catalogue *Raisonné*, the study of the history, materials and techniques of Amadeo de Souza-Cardoso was one of the main focuses of this project which had three PhD projects related with the study of this artist. The present dissertation refers to one of them.

[11]The author of this dissertation and: Margarida Elias, *Columbano at his Time (1857-1929)*, FCSH-UNL, 2011; Cristina Montagner, *The brushstroke and materials of Amadeo de Souza-Cardoso combined in an authentication tool*, February 2015; Diogo Sanches, *Conservation, materials and techniques in oil painting of Tomás d'Anunciação, Cristino da Silva and Miguel Ângelo Lupi,* November 2016; Ângela Ferraz, *Materials and techniques of oil painting in Portugal (1836-1914): study of the documental sources*, January 2018; Marta Félix Campos, *Materials and techniques in Portuguese Naturalism: the cases of António Silva Porto and João Marques de Oliveira* and Vanessa Otero, *Bright colours: historically accurate reconstructions of Amadeo's palette*.

b) Research motivation

Working in collaboration with FCG, the principal motivation behind the study presented in this PhD dissertation is related to the characterisation of Amadeo de Souza-Cardoso's early career in what concerns its history, materials and techniques. For this purpose, the manuscript *La Légende de Saint Julien l'Hospitalier* (1912), from the collection of MG-MC, was selected as case study, following the study presented by the philosopher Maria Filomena Molder in her essays for the *facsimile* versions of Amadeo's manuscript published in 2006. In the panorama of all works performed by the artist during that period (1907-1912), *La Légende* is peculiar. First, it is Amadeo's single artist's book addressing interesting issues which establish bridges between modernism and medieval illuminated manuscripts. Second, this work marks the terminus of the artist's period most dedicated to drawing. As previously referred, 1912 was the year that many things changed in Souza-Cardoso's artistic career. After *La Légende*, the artist's pictorial language changed as the "velocity" of his modernity required. Finally, the manuscript, as composite of different materials (bookbinding, support, colours and other) presents itself as a challenge for conservation.

c) The central aims and scope of the dissertation

The goal of this dissertation is the study of the history, materials and techniques of Amadeo de Souza-Cardoso's *La Légende de Saint Julien l'Hospitalier*, as emblematic work of the artist at the beginning of his career. As part of the *Crossing Borders* project, it aims to fill some of the project tasks. Therefore, the specific objectives of this work are as follows:

(i) To place *La Légende* in the panorama of the Portuguese and international artist's books of the early 20th century and to better understand the sources that inspired the artist, namely, how and how much the medieval illuminated manuscripts influenced Amadeo in the production of this piece;

(ii) To characterise the materials and techniques used by the artist in the production of *La Légende* through an *in situ* multi-analytical approach. Fibre Optic Reflectance Spectroscopy (FORS) has been applied in the analysis of manuscripts and graphic documents[12]. This study aims to determine the advantages and drawbacks of the technique in the investigation of the present case study, namely in comparison with Raman microscopy;

[12]Cf. Montagner *et al.* 2011; Picollo *et al.* 2011; Doherty *et al.* 2013.

(iii) To establish an adequate strategy of preventive conservation of this single manuscript at the museum;

(iv) To create a suitable FORS database of watercolour paints, prepared to mimic cultural heritage surfaces and for the analyses of other graphic documents. This database was made available to the scientific community through the *Istituto di Fisica Applicata "Nello Carrara"* (IFAC-CNR) website.

The experimental work was developed in the following research centres:

- Department of Conservation and Restoration, *Faculdade de Ciências e Tecnologia – Universidade Nova de Lisboa*, Campus Caparica, 2829-516 Caparica, Portugal;

- REQUIMTE-LAQV, *Faculdade de Ciências e Tecnologia – Universidade Nova de Lisboa, Campus Caparica*, 2829-516 Caparica, Portugal;

- VICARTE Research Unit, *Vidro e Cerâmica para as Artes*, *Faculdade de Ciências e Tecnologia – Universidade Nova de Lisboa*, 2829-516 Caparica, Portugal;

- *Istituto di Fisica Applicata "Nello Carrara"* (IFAC-CNR), via Madonna del Piano, 10, 50019 Sesto Fiorentino, Florence, Italy.

e) Outline of the thesis

This dissertation is divided into three main parts:

Part 1 concerns the investigation of *La Légende de Saint Julien l'Hospitalier* in an art historical perspective. **Chapter 1 – On Amadeo de Souza Cardoso** provides a review of the artist's biography, focusing on his early career (1907-1912) and driving to the production of *La Légende de Saint Julien l'Hospitalier*. **Chapter 2 – A modernist codex: *La Légende de Saint Julien l'Hospitalier*** begins with a critical review of Maria Filomena Molder's essays for the *facsimile* editions. In this chapter are also discussed the results that allow to define *La Légende* as an artist's book (*livre d'artiste*) and its place in the context of the Parisian, Russian and Portuguese panorama. Moreover, the different sources that inspired Souza-Cardoso in the creation of this manuscript are studied as well as the dialogues between modernism and medievalism in this work.

Part 2 deals with the study of the materials and techniques of *La Légende de Saint Julien l'Hospitalier*. **Chapter 3 – The art of beauty: the construction and state of conservation of *La Légende*** analyses the structure of the artist's book, its state of conservation and Amadeo's artistic technique in this work. **Chapter 4 – Beyond what the eyes see: pictorial materials and technique of *La Légende*** discloses the artist's pictorial palette used in this manuscript, which was identified through an *in situ* multi-analytical approach. The obtained palette is compared with the set of colours used by the painter in the middle and last years of his short career, according to previous studies. In addition, the results of the colour mapping in *La Légende de Saint Julien l'Hospitalier* and an essay on the chromatic richness in the manuscript are also presented. The guidelines for the preventive conservation of *La Légende* are given at the end of this chapter.

Part 3 focus on FORS methodology and present a set of UV-Vis-NIR reflectance spectra of modern watercolour paints, which was created for the analytical characterisation of the colours applied in the creative process of *La Légende* presented in Chapter 4. **Chapter 5 – Introduction to UV-Vis--NIR Fibre Optic Reflectance Spectroscopy** presents an overview of the technique to the reader. **Chapter 6 – Modern Watercolours Reflectance Spectra Database** reports the watercolour mock-ups preparation, the instrumental set-up and the results and discussion of the spectral archive obtained.

The dissertation ends with **Chapter 7 – Concluding remarks and future research**, where the final remarks and some suggestions for future work are presented.

f) Research methodology

The starting point of this study consisted in a bibliographic review on Amadeo de Souza-Cardoso's career focusing, in particular, in the period between 1907-1912 and on his work *La Légende de Saint Julien l'Hospitalier* (1912). In parallel, a research on Gustave Flaubert's tale production and on the story of the catholic saint Julian the Hospitaller, was carried out.

The investigation in an art historical perspective of the manuscript began with a critical review of the essays written by Maria Filomena Molder, since they represent the most complete analysis of Amadeo's *La Légende* until now.

No consistent study exists reporting *La Légende de Saint Julien l'Hospitalier* as an artist's book. Thus, the aspects that allow defining it in this artwork category were analysed. In addition, a data-set of Parisian, Russian and Portuguese artist's book until 1912 was organised. The information was collected from related bibliography and museum's collections catalogues. The aim was to place *La Légende* in the context of artist's books universe production in the early 20th century.

As referred by Wassily Kandinsky, *every artwork is a child of its age* [Kandinsky 2017]. Thus, the several sources in which the creativity of Amadeo de Souza-Cardoso was inspired were identified. For the purpose, the artist's estate at BA-FCG was analysed in great detail, as well as photographs, postcards, images of paintings from the places that Amadeo visited in Brittany and pieces from some of his contemporaries. The several pages of *La Légende* were compared not only with modernist works but also, with medieval codices.

In the study of the materials and techniques of *La Légende de Saint Julien l'Hospitalier*, the construction and conservation state of the manuscript was firstly characterised by visual examination methods (optical microscopy and transmitted light) for a deeper understanding of the bookbinding and text block. Secondly, Amadeo's artistic technique was observed at a macro and microscopic level aiming to better know the *modus operandi* followed by the artist. In this step, the *Manual de Pintura* by Manuel de Macedo [Macedo 1898] was used as an auxiliary tool. For complementary data, four professional illustrators collaborated in this research by analysing high resolution photographs of the several pages of *La Légende*.

The pictorial palette used by the artist in the conception of this artwork was identified by means of *in situ* techniques. UV-Vis-NIR Fibre Optic Reflectance Spectroscopy (FORS), Raman microscopy and μ-Energy-Dispersive X-Ray Fluorescence Spectroscopy were used.

Since there was a lack of adequate FORS databases for modern watercolour paints, it was created a library of UV-Vis-NIR reflectance spectra which was employed in the analysis of Amadeo's *La Légende de Saint Julien l'Hospitalier*. For the scope, a set of watercolour paints were prepared with different dilutions. The pigments were selected basing on those produced in the early 20th century, mainly the colours preferred by Amadeo de Souza-Cardoso.

The identified palette was compared with the ones obtained in previous studies, concerning the artist's career between 1913-1916 and in 1917.

Other materials present in the manuscript were also characterised by this *in situ* approach. For the identification of the binding medium present in the colours used, a chemometric approach using principal component analysis (PCA) was tested.

Following the paradigm of a recent study carried out at DCR-FCT-UNL on the colour meaning in Portuguese medieval illuminations, a similar study was performed in the case of *La Légende*. The approach was made by means of mathematical algorithms. This study aimed to propose an interpretation for the relationship established between the chromatic richness of *La Légende* and the way the artist communicated his perception of Gustave Flaubert's tale to the reader.

Finally, from the characterisation of the materials and techniques employed in *La Légende de Saint Julien l'Hospitalier*, preventive conservation guidelines were established for the museum where the manuscript is kept in custody.

DESCRIPTION OF *LA LÉGENDE DE SAINT JULIEN L'HOSPITALIER*

Title:
La Légende de Saint Julien l'Hospitalier
(text by Gustave Flaubert (1875-1876))

Artist: Amadeo de Souza-Cardoso (1887-1918)

Inventory number: DP1822

Place and Date: Brittany and Paris (France), 1912

Category: Album type book

Dimensions:
274 mm x 239 mm x 42 mm (with the bookbinding)
264 mm x 215 mm x 32 mm (without the bookbinding)

Main part of the manuscript: 143 mounted sheets of paper (83 of them illustrated)[13]

Bookbinding: Album-type. Pages inserted in guards.

Owner: FCG (Lisbon)

Current location: MG-MC

Observations:
Donated to this Foundation by Lucie de Souza-Cardoso (Amadeo's widow) in 1987.

Unique copy, handwritten and illustrated by the artist.

The manuscript has never been restored.

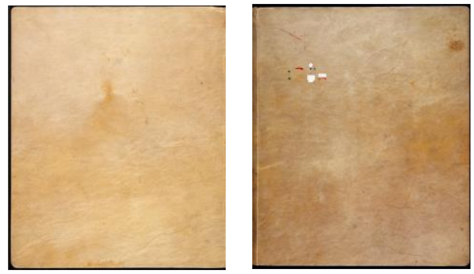


Figure 1.1. Bookbinding (back and front cover), MG-MC.

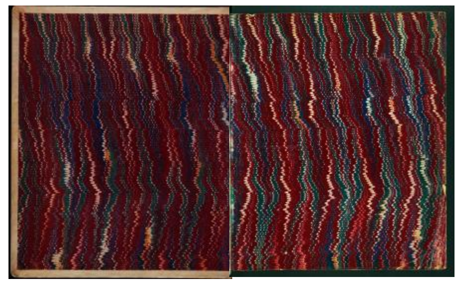


Figure 1.2. Endpaper in marbled paper (pastedown and fly-leaf), MG-MC.

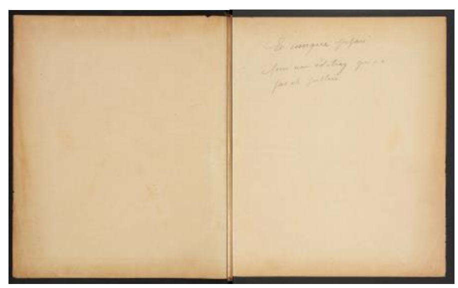


Figure 1.3. Fly-leaves, MG-MC.

Figure 1.4. Example from the text block of the manuscript, p.80, MG-MC.

[13]All pages are presented in *Appendix A1.1*.

1

AN ART HISTORICAL PERSPECTIVE OF *LA LÉGENDE DE SAINT JULIEN L'HOSPITALIER*

I always have dreams, a powerful and restless youth;
a burning desire for sensations that are ever new, for adventures.[14]

Amadeo de Souza-Cardoso[15], 1908.

CHAPTER 1: On Amadeo de Souza-Cardoso

1.1 A brief biography

Amadeu Ferreira de Sousa Cardoso (***Figure 1.5***) was born on November 14, 1887 in Manhufe, in the parish of Mancelos, near Amarante (Northern Portugal) in a catholic and monarchic family, from the rural bourgeoisie [França 1972, 12; Pamplona 1983, 31; Alfaro 2007, 21; Freitas 2008, 17]. He was the fifth child of José Emídio de Sousa Cardoso, a rich wine producer, and Emília Cândido Ferreira Cardoso [Alfaro 2007, 21; Cardoso 2008, 46]. Amadeo had five sisters (Laura, Alice, Helena, Graça and Aurélia) and three brothers (Ernesto, Alberto and António) [Cardoso 2008, 46]. His uncle Francisco Cardoso[16] was the confident and supporter of the nephew's artistic ambitions [França 1972, 12; Alfaro 2007, 88; Freitas 2008, 423].

Figure 1.5. Amadeo de Souza-Cardoso, Paris, 1907 (detail), BA-FCG.

Every summer, Amadeo de Souza-Cardoso used to go with his family to Espinho, near Porto, in the Portuguese seaside [Alfaro 2007, 27]. At one of these occasions, at the age of 17, he met and established a close friendship with Manuel Laranjeira (1877-1912), a physician, poet and essayist. Together, they started attending cultural gatherings at the *Café Chinez*, contacting with a restricted literary and artistic circle[17] from Northern Portugal [Alfaro 2010, 17]. Laranjeira forthwith recognised Amadeo's artistic talent [Alfaro 2010, 17; Gonçalves 2011, 95]. From their correspondence, it is clearly noticeable the intense exchange of ideas and their references to some writers. This friendship was important for Amadeo's cultural and artistic progress [Gonçalves 2011, 95].

[14]From a letter from Amadeo to his uncle Francisco [apud Alfaro 2007, 88] (Translation by the author of this dissertation).
[15]The artist started signing with his artistic name "Amadeo de Souza-Cardoso" in c. 1908-1909 [Cf. Freitas 2008b, 135].
[16]Brother of Amadeo's mother [Cf. Cardoso 2008, 46].
[17]Teixeira de Pascoaes, João de Barros, António Carneiro, Ramiro Mourão, Pedro Blanco (composer and pianist), Miguel de Unamuno and Augusto Santo (sculptor) [Alfaro 2010, 17].

Regarding Amadeo's drawings (and caricatures), Manuel Laranjeira was simultaneously the biggest impeller and critic of his work [Alfaro 2007, 43].

Amadeo de Souza-Cardoso studied in Amarante and in Coimbra [Alfaro 2007, 21]. With the intention to become an architect, he attended afterwards the Preparatory Drawing Course at the *Real Academia de Belas-Artes* in Lisbon in 1905 [Alfaro 2007, 37]. During that period, Amadeo drew his first caricatures that he shared by letter with his sister Alice and Laranjeira [Alfaro 2007, 39].

His artistic aspirations led him to Paris. On the day of his 19th birthday, Amadeo de Souza-Cardoso moved to the French capital invoking his wish to continuing his studies in architecture at the *École des Beaux-Arts*. Having financial support of his family, he lived in *Boulevard du Montparnasse.* In order to prepare admission examinations, Amadeo attended lessons at the *Académies Libres* (*Academie Julien*) and later at the Godefroy-Freynet studios in *Boulevard Raspail* [Alfaro 2007, 50].

Figure 1.6. Lucie de Souza-Cardoso, Manhufe, 1915, BA-FCG.

At the time, being more interested in the eruption of the new artistic productions in the French capital, soon the Portuguese artist abandoned his purpose for studying architecture and the production of caricatures and started a career as painter [Freitas 2008, 19].

In 1908, Amadeo met Lucie Meynardi Pecetto (1890--1987) (***Figure 1.6***) daughter of the owner of *Crémerie Chaude* (Montparnasse), who became the companion of his life. Amadeo married her in 1914, in Porto [Alfaro 2007, 214; Freitas 2008, 19]

Immersed in the Parisian artistic milieu, the Portuguese artist had the opportunity to meet some of the protagonists of the *avant-garde* (lit. "vanguard") movements proliferating in the "City of Light" that, as referred by Helena de Freitas, changed the representational canons of the Western European art from whom Amadeo picked important lessons for his work as painter [Freitas 2008, 17]. *Tout le mond connaissant tout le monde*[18] [Ferreira 1995, 62]. A solid social network was being created. Amedeo Modigliani, Anglada Camarasa, Constantin Brancusi, Alexander Archipenko, Robert and Sonia Delaunay, Pablo Picasso, André Derain, Otto Freundlich, Gino Severini, Umberto Boccioni and Francis Picabia were some of the artists with whom Amadeo has cultivated acquaintances and friendship [Alfaro 2007].

The extraordinary evolution of his work occurred in a very short time [Alfaro 2010, 11]. It was characterised by the velocity of experimentation according to the psychological profile of the artist and the

[18]Translation: Everybody knows everybody.

determination to build a personal artistic language [Alfaro 2010, 13; França 2011, 171]. As result, he started participating in the most important modernist exhibitions taking place in Paris: *Salon des Indépendants* (1911 and 1912) and *Salon d'Automne* (1912) [Alfaro 2010, 11; Silva 2016, 17].

Amadeo also showed his work outside the Parisian circuit. In 1913, his friend Walter Pach – an American painter and critic – invited Souza-Cardoso to participate in the first great event of modern art in USA, the *Armory Show* (International Exhibition of Modern Art) held in New York, Boston and Chicago [Alfaro 2010, 47; Gonçalves 2011, 98; Silva 2016, 17]. In the same year, he showed some of his works in the *Erster Deutscher Herbstsalon* organised by the Gallery *Der Sturm* in Berlin, invited by Robert Delaunay. In the following year, Amadeo also exhibited in Cologne at the *Deutsche Werkbundausstellung*. He also participated in the Exhibition of Painting and Sculpture in *The Modern Spirit* at the Milwaukee Art Society and in London at the Salon of the Allied Artists' Association, as well in an exhibition in Hamburg [Alfaro 2010, 83-84; Silva 2016, 17].

During his stay in Paris (1906-1914), Amadeo returned home to Manhufe, many times spending long holidays with his family [Freitas 2008, 18]. He also travelled around Brittany (1907 and 1912), Normandy (1907), Madrid (1908 and 1911), Salamanca, Toledo, Ávila and Burgos (1908), Brussels (1910) and Barcelona (1914) [Alfaro 2007]. Short after this last trip, Amadeo and Lucie came back to Portugal in order to prepare their wedding but they were surprised by news of World War I starting. And so, the Portuguese painter was unable to return to Paris [Alfaro 2007, 214].

In 1915, Robert and Sonia Delaunay who Amadeo had met in Paris in 1911, escaped from war finding refuge in Vila do Conde, 80 Km away from Manhufe. Together with Amadeo, the Portuguese artists Eduardo Viana, José de Almada Negreiros, José Pacheco and the Russian artist Wladimir-Baranoff Rossiné, they started the *Corporation Nouvelle* with many joint artistic projects. Later, also Apollinaire and Blaise Cendrars joined them [Ferreira 1972, 6; O'Neill 1999, 72; Leal 2015; Silva 2016, 23]. In Portugal, Amadeo de Souza-Cardoso occupied his time painting, hunting and riding in the mountains. Isolated in Manhufe from his international companions, Amadeo wrote to the Delaunay couple communicating about his intense artistic activity: *Je travaille toujours vertigineusement; Je travaille comme un animal*[19] [Alfaro 2007, 219; Alfaro 2010, 61].

Amadeo's last paintings, produced between 1916 and 1917, are considered highly innovative, presenting peculiar elements such as sand, mirrors, hair clips and glasses (examples in ***Figure 1.7***) [Gonçalves 2011, 104; Montagner 2015, 15]. In 1916, Souza-Cardoso showed, for the first time in Portugal, pieces of modern art in two exhibitions entitled *Abstraccionismo* held in Porto at *Salão de Festas do Jardim Passos Manuel* and a month later in Lisbon at *Liga Naval* (*Palácio Calhariz*) [Silva 2016, 35; Soares 2016, 47]. In general, these exhibitions were received with interest and curiosity by the public[20],

[19]Translation: I always work vertiginously; I work like an animal.

[20]From a letter by Amadeo to his uncle Francisco (November 18, 1916): *I ended my exhibition. But on that same day, people continued to flock into it. The first ones to arrive were able to come in. Then I asked to close the doors because the influx of visitors has grown rapidly* [Damásio 2016, 349 apud Soares 2016, 57] (Translation by the author of this dissertation).

as widely reported by the Portuguese press at the time, with some exceptions[21] [Soares 2016, 55]. In fact, they also caused feelings of incomprehension and scandal in a few people, leading to the point the artist being victim of physical aggression [Alfaro 2010, 68; Soares 2016, 57]. Almada Negreiros and Fernando Pessoa were the few modernist voices that spoke highly of the painter publicly. Pessoa defined Amadeo as *the most celebrated advanced Portuguese painter*[22] [Wohl 1982, 167]. During that period, Amadeo de Souza-Cardoso established contact with the group of futurist artists from Lisbon: Santa-Rita, Almada, Pessoa and Raul Leal and had collaborated in the magazine *Orpheu (number* 3) that never saw the light [Júdice 1990; Leal 1999, 20; Soares 2014, 5]. Bernardo Pinto de Almeida refers that this publication would have given to Amadeo de Souza-Cardoso the recognition that he deserved at the time [Pinto de Almeida 2008].

From the correspondence that Amadeo exchanged with his artist friends, is clear that he longed to return to Paris [Freitas 2006, 65; Alfaro 2010, 77; França 2011, 171; Silva 2016, 25]. However, he died in Espinho on October 25, 1918, at the age of 30, victim of the Spanish flu [Freitas 2008, 422; Alfaro 2010, 78]. A few weeks later, the World War I ended.

This Portuguese artist left a unique oeuvre in the context of the Portuguese painting of the early 20th century. Otto Freundlich's words: *Our friend Cardoso died of the flu at an early age and the course of his short artistic life was brilliant. Fate granted him rich gifts which he developed abundantly very early in life*[23]. Citing António Lino:

> *The greatest praise we can attribute to the works of Souza-Cardoso is that it is not necessary to place them in its time in order to exalt them. Even today his works confirm their presence, their present day attraction and value, by the side of the greatest names of modern art*[24] [Lino 2008, 66].

Figure 1.7. *From left to right:* Untitled (*Brut 300 TSF*) (1917); Untitled (*Entrada*) (1917) and Untitled (*Coty*) (1917), MG-MC.

[21] Cf. AA.VV. Exhibition Catalogue Amadeo de Souza-Cardoso 2016-1916 Porto-Lisboa, 275-287.
[22] From a letter by Fernando Pessoa to Armando Côrtes Rodrigues (1916) [apud Wohl 1982, 167].
[23] Freundlich 1930 apud Freitas 2008, 28 (Translation by the author of this dissertation).
[24] Translation by the author of this dissertation.

1.2 Early career: 1907-1912

In November 1906, when Amadeo de Souza-Cardoso arrived in the French capital[25], transformations of crucial importance were occurring in the artistic panorama with consequences to the art of Western Europe at that period [Wohl 1982, 168; Grenier 2016, 27]. A month before, Paul Cézanne (1839-1906) had passed away in Aix-en-Provence [França 1999, 27; França 2011, 174]. In the secrecy of his studio in *Le Bateau-Lavoir* (Montmartre), Pablo Picasso (1881-1973) started painting *Les Demoiselles d'Avignon*[26] with the influence of African tribal masks that would be considered as a proto-cubist work [França 1972, 11; Miller 2001, 19; Grenier 2013, 11]. The previous year, at the *Salon d'Automme* (*Grand Palais – Champs Elysées*), Henri Matisse (1859-1964) and a group of painters nicknamed humorously as *fauves* (lit. "wild") by the critic Louis Vauxcelles[27] (1870-1943), presented their works [Fermoso García 2006, 6; Le Bihan 2006, 9]. The explosion of colours caused sensation in some [Fermoso García 2006, 6]; and provoked reactions of scandal to others [Grenier 2013, 11]. This new generation of artists made of Fauvism the trailblazer of multiple *avant-garde* movements at the beginning of the 20th century in Europe. The art of the 19th century was definitely unfashionable [Lapa 2006, 7].

Catarina Alfaro mentioned that in that period, *Paris was no more the capital of the decorative arts and the experimental center of new architectural tendencies, but the universe of painting and sculpture*[28] [Alfaro 2007, 59]. Thus, a wave of young artists from several nationalities was attracted to this *center of civilization and knowledge of the world*[29], animated by its atmosphere of creativity and high artistic production. As a cosmopolitan city, Paris offered cultural exchanges and an artistic milieu where different generations of artists and aesthetics cohabited [Grenier 2013, 11]. The city had the perfect conditions for the exchange of creative ideas[30] [Voorhies 2004]. In this context, the term *École de Paris* (School of Paris) refers to the colony of French and foreign artists – painters, sculptors, photographers - that lived and worked in Paris between 1900 and 1940 [Voorhies 2004; Silver 1999, 51]. This was the "School" of those artists that did not belong to any school but, instead followed a diversity of styles and techniques that would captivate Amadeo [Pamplona 1983, 14]. The main artistic movements related with the *École de Paris* included Fauvism, Cubism and Orphism [Michaelides 2007, 128]. Initially, this colony of artists was concentrated in Montmartre. Though, in the early 1910s, it moved to Montparnasse, where the Portuguese artist chose to live during his eight-year stay in Paris, despite having changed studio or apartment several times [Voorhies 2004; Alfaro 2007, 59].

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[25]The artists Amedeo Modigliani (1884-1920), Gino Severini (1883-1966) and Juan Gris (1887-1927) arrived in Paris about the same time [Alfaro 2007, 284].
[26]The painting was presented on July 1907 [Kelder 1986, 273; FitzGerald 1996, 30].
[27]Later, Vauxcelles also coined the term "Cubism" [Miller 2001, 295].
[28]Translation by the author of this dissertation.
[29]Amadeo's expression used to characterise Paris, from a letter to his sister Helena Cardoso (April 1907) [apud Alfaro 2007, 59] (Translation by the author of this dissertation).
[30]Artists used to meet in their studios or in academies, neighborhoods, cafés (e.g. *Closeries des Lilas*), gatherings etc. These places were favorable for confrontation or exchange of ideas not only for artists but also for writers [Cf. Silver 1999, 54; Alfaro 2007, 158; Freitas 2008, 19; Grenier 2013, 11].

During the 19th and 20th centuries, many Portuguese artists – mainly painters[31] – aimed to study in this World Center of Art, financially supported by scholarships from the State or by their own families [França 2011, 174]. Quoting José-Augusto França:

> *Paris was (thus) for all Portuguese artists, an horizon of art and intelligence, the capital of Europe and West and on top of that the 'capital of the 19th century', that ended in a cascade of aesthetic which in Portugal were ignored*[32] [França 2011, 174].

According to this same author, it is possible that Amadeo was encouraged in architecture by the example of the architects José Marques da Silva (1869-1947) and Miguel Ventura Terra (1866-1919) who had returned from Paris a decade before, with diplomas that were accredited in Porto and in Lisbon [França 2011, 174].

In his first years in the "City of Light", Amadeo joined the group of Portuguese artists that were also living in Montparnasse. Among them were Emmerico Nunes (1888-1968), Manuel Bentes (1885-1961), Eduardo Viana (1881-1967) but also many others[33] [Alfaro 2007, 50; Gonçalves 2011, 95]. However, as it will be seen, as time went by Amadeo de Souza-Cardoso left his compatriots, as he very soon realised that his way was another one and refused any kind of *mediocrity*[34] [Freitas 2008, 19]. As he wrote:

> *There are people who accuse me of being pretentious in wanting to be different. This doesn't affect me as they can think what they want. I have got my reasons and that is enough. I know what pleases in general; I displease in general. To a certain extent, it is not less flattering*[35].

The talent, the culture, the curiosity, the passion for his own work, the [good] ambition[36], the determination to follow an original way, the financial support of his family, the good looks, and his self--confidence were aspects that gave Souza-Cardoso the safety to fly higher. With an intrinsic modernist spirit, Amadeo was an active member of the *École the Paris*, fact that provided the vitality of his oeuvre.

But, in 1906, Amadeo de Souza-Cardoso was still focused in his architectural studies, preparing himself for the entrance exam to the *École des Beaux Arts*, and in the production of caricatures [Alfaro 2010, 81; França 2011, 174].

In the following section, the most relevant occurrences during Amadeo de Souza-Cardoso's early career (1907-1912) will be chronologically highlighted as prelude to the production of the *livre d'artiste La Légende de Saint Julien l'Hospitalier* (1912).

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[31] From the set of artists studied in the *Crossing Borders* project: João Cristino da Silva (1829-1877), António Silva Porto (1850-1893), João Marques de Oliveira (1853-1927) and Columbano Bordallo-Pinheiro (1857-1929) [Cf. Lisboa 2007].
[32] Translation by the author of this dissertation.
[33] Amadeo also met Thomaz da Costa, Francis Smith (with whom Amadeo arrived in Paris), Acácio Lino, Alberto Cardoso, Artur Alves, Domingos Rebelo, Afonso Ferraz (arquitect), José de Oliveira Ferreira (sculptor) and José Pedro Cruz and moreover the Portuguese Medicine students Dr. Carlos Balbino Dias and Dr. Óscar Moreno [Alfaro 2007, 50].
[34] From a letter Amadeo wrote to his uncle Francisco between 1910-1911 [apud Pamplona 1983, 26].
[35] *Ibidem* (Translation by the author of this dissertation).
[36] From the letter to his sister Helena Cardoso (April 1907) [apud Alfaro 2007, 59].

1907

Amadeo spent that year visiting museums and galleries, travelling, studying architectural drawing and practicing caricature [Alfaro 2007, 59; Gonçalves 2011, 95]. However in that period, he had doubts about his vocation as an architect, as revealed in a letter to his friend Manuel Laranjeira in January, manifesting a predilection for caricature[37]. To this last activity, Amadeo devoted himself until the end of 1910. Laranjeira was one of the main targets of his drawings (***Figure 1.8***) [Alfaro 2007, 103; França 2011, 175]. His improving talent gave him the possibility to start publishing caricatures in Portuguese periodical publications[38] [Alfaro 2007, 59].

Figure 1.8. Caricature of Amadeo with Laranjeira, 1906 (Chinese ink on paper – 110 x 180 mm). Source: *Museu Amadeo de Souza-Cardoso* website: www.amadeosouza-cardoso.pt/

The Portuguese artist seemed to be totally integrated in the French capital. In the letter to his sister Helena, he confided: *Here [Paris] one can breathe. In Portugal, one may feel oppressed*[39].

Between July and October, Amadeo de Souza-Cardoso travelled with the Portuguese artist Eduardo Viana around Normandy and Brittany – an inspiring destination for many artists at the time[40] [Ferreira 1995, 35; Alfaro 2007, 63]. In Pont-l'Abbé, he spent time with his friends (the couple Stervinou), having also visited Brest, Vitré, Quimper, Mont de St. Michel, Rouen and probably also the Bailiwick of Jersey [Alfaro 2007, 63]. A few days before leaving Pont-l'Abbé for Paris – about a month to his birthday - in a letter to his mother, Amadeo wrote: *It will soon be twenty years since life gave me a destiny to fulfil*[41].

Definitely not convinced with his future as an architect, Souza-Cardoso gave up his studies during the summer with the disapproval of his father [Alfaro 2006, 432]. Nevertheless, he was determined to follow an artistic career, maybe as caricaturist.

Already in Paris, the novice artist was overwhelmed by the artistic events occurring in the city. Helena de Freitas noted that: *It is clear and one can understand from his first letters to his family that Amadeo had been in a state of permanent attention and creation since the first day of his stay in Paris*[42] [Freitas 2008, 19]. Thus, it was not from the masters of the Louvre that Amadeo had learned the Parisian lesson. The posthumous retrospective exhibition of Paul Cézanne hosted at the *Salon d'Automne* and

[37]From a letter to Manuel Laranjeira (January 1907): *I admire architecture with great sensitivity, for me it is truly the unique art of greatness; but this extraordinary superior force, that tells me «you can give up on architecture» - no, I don't feel that, I could perfectly leave architecture – and strange as it may seem – it would be a great torture to live aside the caricatures* [apud Alfaro 2010, 57] (Translation by the author of this dissertation).

[38]*O Primeiro de Janeiro* (1907)*, Ilustração Popular* (1908 and 1909)*, Mundo Elegante and Moda Ilustrada* [Cf. Alfaro 2007, 59].

[39]From the letter to his sister Helena Cardoso (April 1907) [apud Alfaro 2007, 59] (Translation by the author of this dissertation).

[40]Cf. Fortes 2010, 68.

[41]From a letter from Amadeo to his mother (Pont-l'Abbé October 3, 1907) [apud Freitas 2006, 22].

[42]Translation by the author of this dissertation.

the opening of the gallery of Daniel-Henry Kahnweiler (1884-1979) with a selection of works of the [future] cubist elite[43], seemed to have contributed to Amadeo's profound inner cultural vision change and consequently for the discovery of his true vocation: being a painter[44].

1908

Amadeo travelled through some Spanish cities in the beginning of the year as confirmed by a letter to Manuel Laranjeira[45]. On one of these travels, he went to Madrid and met the poet and playwright Martinez Sierra (1881-1947) [Alfaro 2007, 77]. He also visited the *Museo del Prado* from which collection the painting *Los Borrachos* (1629) by Diego Velasquez belongs and which Amadeo de Souza-Cardoso and some of his Portuguese companions mimicked in a photograph in April of the same year (***Figure 1.9***). As can be observed, it expresses the joyful atmosphere that was present in their meetings, usually carried out at Emmérico Nunes's studio at *14, Cité Falguière* – a neighbourhood in Montparnasse where many artists lived[46]. Amadeo rented a studio there (number 21) [Alfaro 2007, 84].

Catarina Alfaro refers that the *Académie Russe*, located close to *Cité Falguiére* was inaugurated that same year. Its director was Marie Vassilieff (1884-1957) and it was inspired by Cubism and the Russian folklore. It became an important place for meetings and cultural exchanges in Paris [Alfaro 2007, 89]. The Portuguese artist established contact with some Russian artists in Paris [Grenier 2016, 27].

In that period, Amadeo met Fernand Léger (1881-1955) who introduced him to the circle of cubist painters and it was then that he started publishing caricatures in French newspapers[47] [Alfaro 2007, 91].

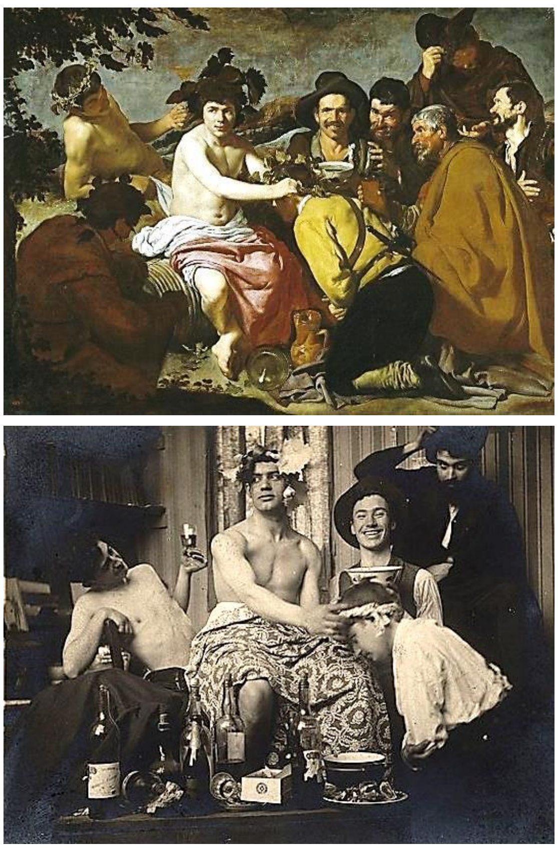

Figure 1.9. *On the top:* Diego Velasquez, *Los Borrachos* (1626-28). Source: Museo Nacional del Prado website: www.museodelprado.es. *Bellow:* Amadeo and some Portuguese companions mimicking *Los Borrachos* (1908), BA-FCG.

[43]Works of Georges Braque, Pablo Picasso, Kees van Dongen, Juan Gris, André Derain and Maurice Vlaminck were exhibited on this occasion [Alfaro 2007, 72].

[44]Cf. Pamplona 1983, 19 and França 1999, 28.

[45]*I have been in Madrid since Thursday morning. I was in Salamanca and soon I will leave to Toledo, Avila, Burgos and Paris* [apud Alfaro 2007, 77] (Translation by the author of this dissertation).

[46]Among these artists were Modigliani, Tsuguharu Foujita, Chaïm Soutine, Kisling, José Pacheco and Diogo de Macedo [*Ibidem*, 84].

[47]According to Catarina Alfaro, Amadeo published caricatures in *Les Tendances Nouvelles* and *La Vie* [*Ibidem*, 91].

1909

Amadeo chose to start attending painting lessons at an *academie libre* – the *Academie Vitti* (Montparnasse) with the Spaniard painter Hermen Anglada Camarasa (1871-1959)[48]. At the time, Anglada was known for the strong chromatist and free movements of his brushstrokes [Pamplona 1983, 20; Gonçalves 2006, 10; Alfaro 2007, 103]. Moreover, he also had a close relationship with the Russian artistic milieu. The friendship between him and Amadeo lasted many years [Alfaro 2007, 103].

It was in this year that Souza-Cardoso's father gave him permission to leave the architectural studies and to dedicate himself to caricature[49]. During this period, the Portuguese painter conciliated the practice of caricature with painting lessons [Alfaro 2007, 103].

Amadeo moved to another studio[50] becoming neighbour of the American writer Gertrude Stein and her brother Leo [Alfaro 2007, 104].

According to many authors, it was in that year that Amadeo de Souza-Cardoso and Amedeo Modigliani (***Figure 1.10***) established an intense friendship[51] [Macedo 1959; Alfaro 2007, 104]. As referred by Catarina Alfaro, probably they had met each other through the poet Max Jacob (1876-1944) – a common friend – or at *Cité Falguière* where the Italian painter also lived [Modigliani 1961, 67; Alfaro 2007, 106]. It is also very possible a connection between Amadeo and the physician Paul Alexander (1881-1968) who ran a colony of penniless artists at Paris' *7, Rue du Delta* [Modigliani 1961, 51; Alfaro 2007, 106]. Alexander was Modigliani's patron at the time. Through Dedo[52], Amadeo met the sculptors Constantin Brancusi (1876-1957) – as Modigliani, was member of the Delta colony – and Alexander Archipenko (1887-1964) [Alfaro 2007, 110]. It is quite likely that these new and lasting friendships and the artistic empathy between them were the reason why Souza--Cardoso decided to move away from his Portuguese companions.

Figure 1.10. Amedeo Modigliani [Belém and Ramalho 2009, 90].

On May, the exuberant shows of the *Ballets Russes*[53] were inaugurated in Paris at the *Théâtre du Châtelet*, fact that caught Amadeo's attention as we shall see [Alfaro 2007, 110].

[48]According to França it is not clear the reason why Amadeo chose this master. However, this was the way how he entered in the Parisian artistic circuit [França 1999, 28].
[49]After Amadeo's decision to abandon the architectural studies, his family wanted him to work in the family businesses. However, he refused and was adamant to follow an artistic career, a fact that at the beginning was not well received by his own family [Cf. Alfaro 2007, 81-83].
[50]Address: *27, Rue des Fleurus*, Paris [*Ibidem*, 104].
[51]Jeanne Modigliani stated that: *Cardoso was to Modigliani not only his single close friend of that period, but the unique true artistic friend of all his life* [Modigliani 1961, 68] (Translation by the author of this dissertation).
[52]This was the way how Modigliani was called by his family and close friends [Cf. Modigliani 1961 and Parisot 2006].
[53]It was directed by Sergei Diaghilev (1872-1929). At the time, Leon Bakst (1866-1924) was one of the main designers of the sets and costumes [Woodcock 2010, 129].

1910

Amadeo and Lucie travelled to Belgium for a three-month stay and visited the Universal Exhibition – Brussels 1910 (***Figure 1.11***) and, in the occasion, the *Exposition Retrospective: Exposition d'Art Ancien – Les Arts au XVII Siècle* and the *Salon International des Beaux-Arts* [Alfaro 2010, 26]. The Portuguese artist was fascinated upon visiting the works of the Flemish "primitives" as revealed in the letters sent to his uncle Francisco:

Figure 1.11. The official poster of *Brussels 1910* [Jaumais and Barcels 2010, 95].

> *I spend my days with some "primitive" painters who are my idols. I owe them part of the great evolution that has caught my spirit. [I look at] and talk [with these paintings] all mornings and they tell me great things to which I listen attentively. These great ancient souls have the greatest admiration of my soul*[54] [Alfaro 2007, 121].

The interest for the ancient masters was already manifested by the painter with the acquisition of a set of books of artists[55] from many countries [Ferreira 1987, 12].

Amadeo de Souza-Cardoso spent the rest of the summer holidays in Manhufe with his family. From the regular correspondence with Lucie it is clear one of his main personality trades – his emotional instability:

> *It is necessary that you understand that I possess a complicated spirit prone to crises, that my moral and intellectual state suffers from unstoppable demonstrations of violence of all sorts and that I possess more phases than the moon itself. You can't imagine what effect my homeland has up on me this time. What is true is that I feel bad with myself, a feeling of inferiority and it is horrible. I suffered from this in Paris and I want to call it an artistic phase that I am going through. Maybe when I start to work, ripping away or at least making an effort to express my state of mind, maybe I will get better, certainly I will get better"*[56].

Amadeo was working at furious pace and, back in Paris he sent some pieces to the *Salons,* where the artists of the *École de Paris* were exhibiting their works [Alfaro 2007, 133].

The friendship and artistic complicity between Amadeo, Modigliani and Brancusi became more intense [Gonçalves 2006, 16; Alfaro 2007, 134].

Finally, it was also the year when Amadeo de Souza-Cardoso's father recognised the artistic vocation of his son and built him a studio in Manhufe – *Casa do Ribeiro* – where the Portuguese artist would live with Lucie from 1914 until the end of his life [Alfaro 2007, 115].

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[54]Letter by Amadeo to his uncle Francisco (Sunday, 6 [1910]) [Pamplona 1983 apud Alfaro 2007, 293] (Translation by the author of this dissertation).

[55]Amadeo bought books about the following artists: De Hooch, Vermeer, Giotto, Fra Angelico, Rembrandt, Bennozo Gozzoli, Velasquez and a collection of drawings from the Albertina Museum in Vienna [Ferreira 1987, 12; Alfaro 2010, 27].

[56]Letter by Amadeo from Manhufe to Lucie [apud Alfaro 2007, 127] (Translation by the author of this dissertation).

Amadeo and Modigliani inaugurated a joint exhibition at Souza-Cardoso's new and luxurious studio[57] on Sunday, March 5, which resulted from of their artistic complicity. Brancusi collaborated in the organisation and divulgation of the event which counted with the visit of artists and critics [Ferreira 1995, 61; Parisot 2006, 116; Alfaro 2007, 139]. Among them were Picasso, Guillaume Apollinaire, Max Jacob, Ortiz de Zárate and André Derain [Alfaro 2007, 139]. Amedeo Modigliani presented some of his first sculptures and gouaches, whereas, Amadeo de Souza--Cardoso presented drawings and watercolour paintings [Ferreira 1995, 73; Alfaro 2007, 139].

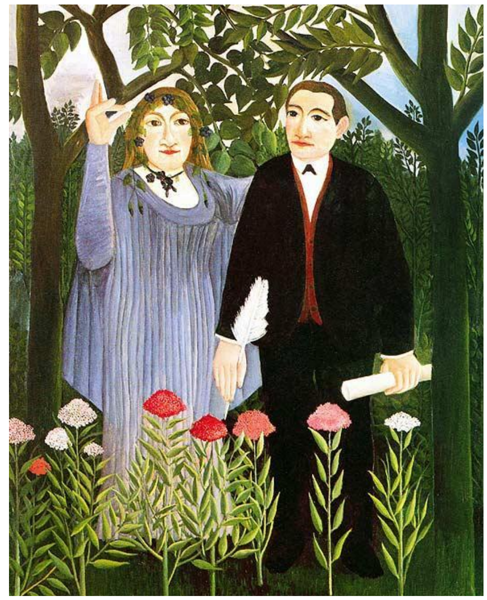

Figure 1.12. *Le Douanier* Rousseau, *Poet et sa muse* (1909).
Source: Kunstmuseum Basel
Website: www.kunstmuseumbasel.ch/

Having reached an artistic maturity, in this year, Amadeo participated in his first international exhibitions. In Paris, he showed works in the *XXVII Salon des Indépendants* which became noted as the first cubist exhibition (rooms 41 and 43). Simultaneously, at room 42, a posthumous retrospective exhibition of Henri Rousseau, *le Douanier* (1844-1910) was carried out. The young Portuguese artist's interest in the works of Rosseau was aroused at this exhibition. He bought the book *Henri Rousseau et les primitifs modernes* by Wilhelm Uhde (edited in 1911) and noted in his agenda the titles of the pieces that caught his attention: *Musicien*; *Singes, Joyeux farceurs*; *Cavalier attaqué par tigre*; *Le Rêve (de Yadwiga)*; *Combat tigre-buffle*; *Vaches en pasturage*; *Jeux de singes*; *Poète et sa muse* (portraits of Apollinaire and Marie Laurencin) (***Figure 1.12***) [Ferreira 1995, 65; Alfaro 2007, 141].

Amadeo de Souza-Cardoso knocked at the door of the house of Sonia Delaunay-Terk (1885--1979) and Robert Delaunay (1885-1941) and introduced himself saying: *Je suis le peintre portugais Amadeo de Souza-Cardoso*[58]. The Portuguese painter conquered their friendship and started attending their Sunday gatherings. Through them he met Blaise Cendrars, Guillaume Apollinaire, Marie Laurencin, Albert Gleizes, Henri Le Fauconnier, Francis Picabia, Marc Chagall, Umberto Boccioni, Paul Klee, Franz Marc and August Macke [Ferreira 1995, 62; Alfaro 2007, 143]. That year, he also met the illustrator, scenographer and painter Umberto Brunelleschi and through him, the painter and critic Walter Pach [Ferreira 1995, 62; Alfaro 2007, 143].

[57]Address: *3, Rue du Colonel-Combes* (near Quai d'Orsay) [Cf. Alfaro 2007, 139].
[58]Translation: I am the Portuguese painter Amadeo de Souza-Cardoso.

Amadeo participated in the *XXVIII Salon des Indépendants* [Alfaro 2007, 149]; and in the *X Salon d'Automne* in this year [Alfaro 2007, 170]. He was also invited by his friend Walter Pach (1883-1958) to participate in the *Armory Show* the following year [Alfaro 2010, 42]; and met the painter and sculptor Otto Freundlich (1878-1943) in the circle of Modigliani's friendships [Alfaro 2007, 158]. The Portuguese painter certainly visited the exhibition *Peintres Futuristes Italiens*[59] organised by Filippo Tommaso Marinetti and Gino Severini [Alfaro 2007, 149].

At this point, Amadeo de Souza-Cardoso was aware of his need to accomplish a constant plastic evolution. He wrote to his uncle Francisco about his works exhibited in the *Salon des Indépendants*:

> *They are works from a past that I seriously consider but which have a lack of interest. Things nowadays show a remarkable evolution and to evolve is a proof of life. Blessed be the young who acknowledge they have erred the following day, thus getting new virtues endlessly*[60].

The echoes of Amadeo's presence were positive. Several critics had written about their impressions[61]. One of the most significant texts was published by the magazine *La Vie*:

> *Amadeo de Souza-Cardoso is one of those races that only bloom in a country of African colours. His sensitivity, his exultant and horsy imagination take on significance in decorative compositions in which the original forms are presented – leaves, horses, boats, fruits and flowers – pure and frank colours – ochre, carmine, ultramarine blue, sap green – take us to exotica. Being born near a river with vegetation presents itself in practically tropical exuberance, the Portuguese Amadeo leaves in a constant dream of fabulous lands conquered by his ancestors: it is symptomatic that this young painter in front of his own frescos that meander in red sails on seas of indigo blue, in which pointed leaves of bizarre shapes proper, in which heraldic beings fish and hunt legendary animals, talks to you enthusiastically of poems long before the 'Lusíadas' which in its turn allows you to evoke the luxurious oriental anal of the Portuguese. Amadeo, thus, developed a singular and distinct art, full of life but controlled, that brings out the reality for adaptation to the decoration of plain surfaces like the walls: the lines and the colours are calculated in such a way as to bring out with elegance the feeling expressed for example in front of the movement of a horse mastered by a human being to make you feel – a particular concern of balance – it is not a compilation of exact forms in the diversity of his plastic interest but definitely in the quality of movements: the finery grace of the animal that gallops*[62].

This same imaginary accompanied Amadeo de Souza-Cardoso in the preparation of the two main works that marked this year: the luxurious album *XX Dessins* and the manuscript *La Légende de Saint Julien l' Hospitalier*. The painter was then 24 years old.

---

[59]Works of Umberto Boccioni, Carlo Carrà, Luigi Russolo, Giacomo Balla and Gino Severini were exhibited on this occasion [Alfaro 2007, 149].
[60]Letter by Amadeo to his uncle Francisco [Pamplona 1983 apud Alfaro 2007, 150] (Translation by the author of this dissertation).
[61]Cf. Alfaro 2007, 150.
[62]*Ibidem*, 151-152 (Translation by the author of this dissertation).

1.2.1 Overview of the painter's early artistic production (1907-1912)

Amadeo de Souza-Cardoso's artistic talent was discovered firstly by his uncle Francisco Cardoso during the artist's childhood [Ferreira 1987, 11; Gonçalves 2006, 6]. His first painting[63] was carried out at about the age of 10, on the doors of a cupboard of his house in Manhufe [Ferreira 1987, 11; Freitas 2008b, 133]. Moreover, at school, Amadeo used to draw faces of his colleagues, teachers and other people or characters on the margins of his books and notebooks [Gonçalves 2006, 6]. Maybe, it was here that his passion for drawing and especially for caricature began.

Turning over the pages of the Volume II of the Catalogue *Raisonné* (2008), one observes that the period of Amadeo's early career can be divided in two main phases. According to the catalogue, in the first phase - between 1907 and 1910 - the subjects of his paintings relate mostly to rural landscapes or interior of cafés. In Rui-Mário Gonçalves's words:

> *Amadeo studied the effects of having colours and shapes interacting with each other. In numerous small format landscapes he carried out extremely innovatory chromatic experiments, starting from a simple shape, whether it was the rounded crowns of trees or the reddish rectangles of the roofs of houses, or yet again, other rectangles depicting white walls. The variation in the sizes of the circles and rectangles followed the same tendency. In contrasting these shapes Amadeo added the complementary colours of green and red* [Gonçalves 2011, 95].

Thus, in this early phase, the relationship between colour and space started to get importance in Amadeo's works. Helena de Freitas underlined that the geometries present in these landscapes are result of an influence of Cézanne (but also of Derain) [Freitas 2008, 20]. Most of these landscapes are probably representations of his homeland – the mountains of Marão [França 2011, 177]. These initial works reveal already an artistic demand and the application of the new visual achievements acquired in Paris in that period [Freitas 2008, 20]. Simultaneously, Amadeo de Souza-Cardoso dedicated himself to caricature [Alfaro 2007, 103].

In the second phase - between 1910 and 1912 - an evolution is observed. Souza-Cardoso drew very much[64]. The works presented in the catalogue *Raisonné* show strokes more defined (stylisation) and elegant shapes close to a "modiglianesque" style[65] [Gonçalves 2006, 18; Dias 2011, 52]. For Amadeo, emotion became important in his work, as revealed in a letter to his uncle: *No one stops making an intense work of art for lack of technique, but for lack of something called temperament*[66].

On August 31, 1912, Amadeo published an album of twenty drawings painted in Chinese-ink between 1911 and 1912 [França 1972, 24; Alfaro 2007, 155]. This time, they go beyond the influence

[63] *Pierrots* (c. 1897) [Cf. Freitas 2008b, 133].

[64] Helena de Freitas observed *that maybe because the drawing is first formed in the thoughts and mind of the artist and because the artist [Amadeo] was at ease in this discipline, he tried new ways of aesthetic that coincided with his close relationship with Modigliani and his circle of friends* [Freitas 2008, 424] (Translation by the author of this dissertation).

[65] Cf. for instance: *Lévriers/Os Galgos* (c.1911) (Cf. Inv. nº 77PI, MG-MC) and *Saut du Lapin/ Salto do Coelho* (1911) (Cf. Inv. nº 1931.514, The Art Institute of Chicago, Arthur Jerome Eddy Memorial Collection).

[66] Letter by Amadeo to his uncle Francisco (1910-1911) [apud Pamplona 1983, 26] (Translation by the author of this dissertation).

of Modigliani. According to the preface by the critic Jérôme Doucet, *they are decorative, they are surprising. [He] knew how to turn a sheet of paper into a kind of oriental tapestry* [Doucet 1986].

The *XX Dessins* were also praised by Louis Vauxcelles that referred:

[Cardoso] created a new world. Nature, animated beings, animals or human creatures, flora and fauna all came out of his hallucinating lyrical brain. Cardoso uses prodigal stylisations, stretches, grooves, twists, `déhanchements' that remind us Greco, the nudes of Cézanne. […] His characters are exaggeratedly long with tiny oval heads. The effect is unexpected, suffocating, and superiorly decorative like medieval tapestries. Barbarious art and, at the same time, 'pueril'. Could we go further to deformation? – No, I don't think so. The technique is secure and firm, reminds me beautiful woods of incisive cuts of [Raoul] Dufy[67]*. The values, not always just are strangely dosed [...] Ce jeune portugais est quelqu'un*[68]*.*

The exotica of this work is allied with modern "Primitivism" with influences not only from the African masks – likewise works of his friends Modigliani and Brancusi – but also of *Art Nouveau* [Leal 1999, 18; Dias 2011, 54].

After the exhibition of the Italian futurist painters in 1912, Amadeo revealed some interest in their works and started painting futurist works using the pointillism technique similar of Gino Severini's at the time [Gonçalves 2011, 98].

Concerning drawing, during the period of the production of *La Légende de Saint Julien l'Hospitalier*, Amadeo adopted a new kind of stroke. The lines are no longer curve and oblique, becoming slender with influences from Cubism[69] [Gonçalves 2006, 18]. Moreover, a new chromaticity rose. Note that the same stroke of *La Légende* accompanied Souza-Cardoso in the realisation of other drawings and watercolour paintings of that year (***Figure 1.13***).

In accordance to José-Augusto França, *an album XX Dessins, irregular but where the style gets better until perfection, an illuminated manuscript 'La Légende de Saint Julien l'Hospitalier' by Flaubert complete this first phase of Amadeo's oeuvre* [França 1960, 6].

Figure 1.13. Some examples – *Top-left*: *Eduardo Viana's portrait*, 1912 (drawing, graphite on paper); *Top-right*: *(title unknown)*, 1912 (drawing, watercolour on paper). *Bellow*: *(title unknown)*, 1912 (drawing, Chinese-ink and watercolour on cardboard), MG-MC.

[67] *See Appendix A2.2.*
[68] Cf. Alfaro 2007, 300 (Translation by the author of this dissertation).
[69] According to the artist Diogo de Macedo, Amadeo was the single Portuguese painter adopting Cubism [Macedo 1960, 44].

1.3 The production of *La Légende de Saint Julien l'Hospitalier* (1912)

According to Catarina Alfaro, during the months of July and August 1912, Amadeo de Souza--Cardoso spent the summer holidays in Brittany with Lucie. They were with their friends Stervinou[70] in Pont-l'Abbé and visited the *Château de Keriolet* in Concarneau (Finistère, Brittany) (***Figure 1.14***). As mentioned by this author, the Portuguese artist remained fascinated with the medieval iconography of the tapestries of this castle and photographed them, carefully [Alfaro 2010, 40].

In that period, in the quietness of the panoramas in Brittany, Amadeo started simultaneously the total copy and illustration of Flaubert's tale *La Légende de Saint Julien l' Hospitalier* while working on the publication of the album *XX Dessins* [Macedo 1959; Alfaro 2010, 40].

The following words of Amadeo's friend Manuel Bentes introduce us well into this manuscript:

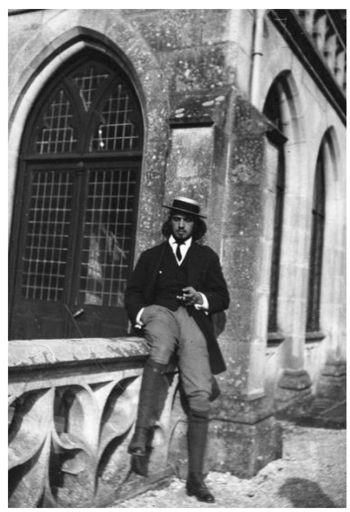

Figure 1.14. *On top:* Amadeo in Brittany. *Bellow-left*: Amadeo at the *Château de Keriolet* (Concarneau); *Bellow--right*: Amadeo with Lucie and Madame Stervinou, BA-FCG.

> *(...) When Amadeo illustrated that work of Flaubert, he had not mastered the technique of oil painting which he so skillfully reveled in his last paintings; but the watercolours and drawings never had any secrets for him. Furthermore, the influences of the schools of that time did not weigh on him in 1912 which was one of the best years of his career and it left his personality intact.*
>
> *The 'Légende' is a work of fine style; the composition is rich and balanced the drawing firm and incisive. There are one hundred forty sheets (the text equally executed in watercolour) worthy of being part of a Portuguese library, it is also worthy that an edition of some the hundreds of examples be edited.*
>
> *We recommend the Portuguese and the Government this fine art"*[71]*.*

[70]It is worth referring that one reported that it was found, in a sales room in Quimper, in July 2010, a drawing by Amadeo de Souza--Cardoso dedicated to Michel Stervinou, dated from September 1912 (Source: http://www.letelegramme.fr/local/finistere-sud/ouest cornouaille/pontlabbe/peinture-noel-le-quere-sur-les-traces-de-souza-cardoso-27-01-2014-2382274.php. Last accessed on January 11, 2018). Note that this drawing is very similar to Souza-Cardoso's oil painting *Landscape* (1912) (Cf. Inv. nº 1931.513, The Art Institute of Chicago, Arthur Jerome Eddy Memorial Collection). The drawing style of both works is similar to that of *La Légende*.

[71]Cf. Amadeo de Souza-Cardoso's estate (BA-FCG) (Translation by the author of this dissertation).

1.3.1 Flaubert's tale context

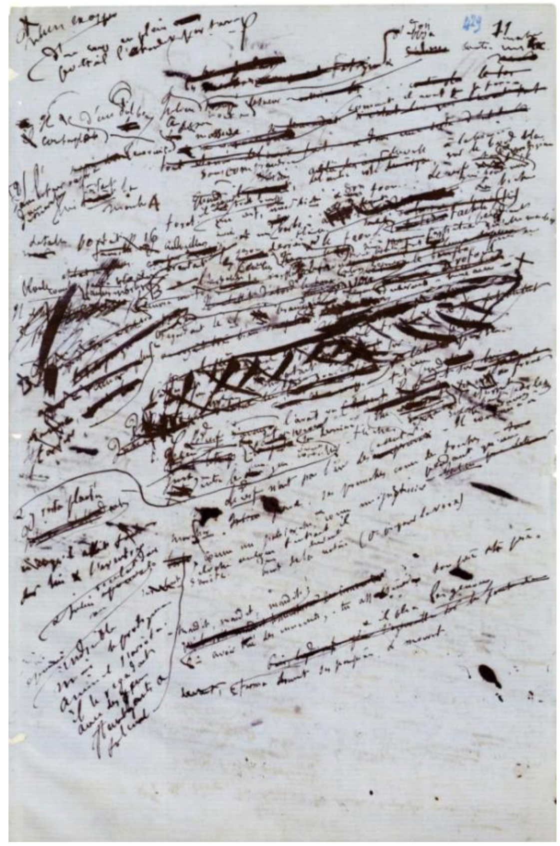

Figure 1.15. *La Légende de Saint Julien l'Hospitalier*, draft by G. Flaubert (p. 429). Source: BNF website: gallica.bnf.fr.

La Légende de Saint Julien l'Hospitalier [The Legend of Saint Julian the Hospitaller] is the second volume of *Three tales*[72] (*Trois contes*, 1877) by the French novelist Gustave Flaubert (Rouen, 1821 – Croisset (Rouen), 1880) (***Figure 1.15***). The other two volumes are entitled *Un Coeur simple* [A simple heart] and *Hérodias*. This collection, produced between September 1875 and February 1877, was Flaubert's last complete oeuvre [Biasi 1999, 10; Molder 2006, 9; Matthey 2008, 7]. Despite being the second volume of the trio, *La Légende de Saint Julien l'Hospitalier* was the first tale to be written [Biasi 1999, 10; Molder 2006, 9]. As a matter of fact, for several years, Flaubert had the story of Saint Julian in mind. In 1834, at the age of 14, with his drawing teacher E.H. Langlois[73] and his class, Flaubert visited the church of Caudebec-en-Caux for the first time. Langlois has invited the students to compare the stained glasses present in that church representing the lives of two hunter saints - Saint Eustache and Saint Hubert – with that of Saint Julian represented in a stained glass window at the cathedral of Rouen [Biasi 1999, 15, Brown 2013, 508]. Flaubert also knew some hagiographic versions of the story of this saint [Molder 2006, 9]. Taking up these memories, almost thirty years later, in his "black year" of 1875, during a stay in Concarneau for family, financial and health reasons, Flaubert started writing *La Légende de Saint Julien l'Hospitalier* [Biasi 1999, 12]. As referred by the literary critic Pierre-Marc de Biasi, according to Gustave Flaubert's letters, the decision to write *La Légende* was related with *a kind of therapeutic exercise, a way to escape from the unbearable pressure of external events*[74] [Biasi 1999, 10].

This tale can be assumed as an "autobiographic temptation" associated with the brutal death of Flaubert's father and young sister and also of his mother, some years later (the image of the double parricide narrated in the tale, almost reminds this fact) [Biasi 1999, 16]. Despite being a short length tale, *La Légende* is richly textured [Brown 2013, 508].

[72]As mentioned by Pierre-Marc de Biasi, critics consider that *Trois contes* is one of Flaubert's most important texts as also *Madame Bovary and L´ Éducation sentimentale* [Biasi 1999, 5]. It was published in 1877 by G. Charpentier [*Ibidem*, 14].
[73]Author of *L'Essai sur la peinture sur verre* [Cf. Langlois, Eustache-Hyacomthe. *Essai historique et descriptif sur verre, ancienne et modern et sur les vitraux les plus remarquables de quelques monuments français et étrangers, suivi de la biographie des plus celebres peintres-verriers*, Frères, 1832].
[74]Translation by the author of this dissertation.

The story of Saint Julian the Hospitaller, as transmitted through the years, takes us to the Middle Age [*see* ***Appendix A1.2***]. This saint is also denominated as *Saint Julian the Poor*[75] and invoked as patron of boatmen, innkeeper and travelers[76] [Stroobants 1991]. Besides that, he is the patron of Macerata (Italy) in which cathedral his relics are kept in custody. Very often is represented with a falcon as attribute [Heinz-Mohr 1995, 155]. This saint was very popular in the Medieval time [Stroobants 1991]. In fact, the cathedral of Chartres (c. 1220) – as well as Rouen's (c. 1280/1290) [*see* ***Appendix A1.3***] – possesses stained glass windows on his life (***Figure 1.16***). Gustave Flaubert ended the tale with the sentence: *Et voilà l' histoire de Saint Julien l'Hospitalier, telle à peu près qu'on la trouve, sur un vitrail d' église dans mon pays*[77]. This *église* [church] refers to the cathedral of Rouen[78]. However, as noted by Biasi, *more or less* alludes that Flaubert, in reality, made an adaptation of the true story of the saint [Biasi 1999, 18].

Figure 1.16. Stained glass window at the cathedral of Rouen on the life of Saint Julian the Hospitaller.
Source: *The Medieval Stained Glass Photographic Archive*
(http://www.therosewindow.com/. Last accessed on February 11, 2017).

[75]Amadeo probably knew the oldest church in Paris, dedicated to *Saint Julien le Pauvre*. It is located close to the cathedral of *Notre Dame* (79 Rue Galande, 75005 Paris, France) [*see Appendix A1.2*].
[76]Curiously, Amadeo used to sign the letters to his mother as *o caminheiro* [the traveller] [Cf. Freitas 2008, 18].
[77]Translation: *And this is the story of Saint Julian the Hospitaller, more or less as it is depicted in a stained glass window in a church in my hometown*.
[78]Note that the façade of this same cathedral was painted by Claude Monet (1840-1926) at different times of the day and year in his studies of light in the 1890s.

1.3.2 Amadeo's copy and illustration context

It was in Concarneau that Flaubert started his written production of the tale *La Légende de Saint Julien l'Hospitalier* in 1875. Coincidentally or not, its ambience also inspired Amadeo de Souza-Cardoso in the creation of the homonym manuscript during the summer of 1912. Furthermore, it is quite probable that some years before, during his travel through Brittany and Normandy in 1907, when in Rouen, Amadeo had visited the cathedral and consequently the stained glass windows related to Saint Julian Hospitaller's life [França 1999, 36; Gonçalves 2006, 19].

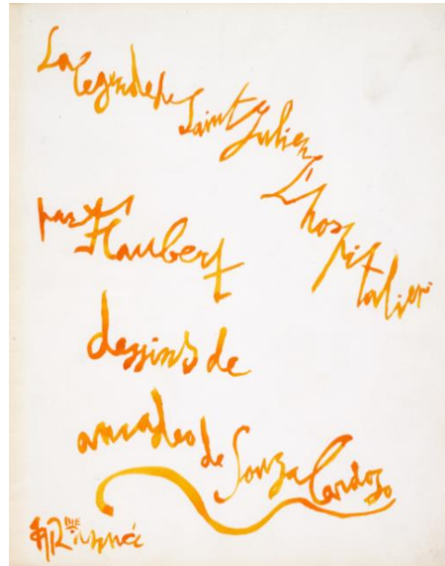

Figure 1.17. Frontispiece of Amadeo's manuscript *La Légende de Saint Julien l'Hospitalier* (1912), p. 2, MG-MC.

Maria Filomena Molder mentioned in the opening of her essays for the *facsimile* versions of *La Légende* that 1912 was *the year of great 'fertility'* for Amadeo [Molder 2006, 10]. Besides that, it is considered the year of Amadeo's artistic affirmation. The success acquired with the participation in the Parisian *Salons* was also important for the achievement of this goal. However, from the correspondence exchanged between Amadeo and Lucie during the Christmas time of 1912, it is clear that the presentation of the manuscript *La Légende* to his family in Manhufe was the key moment in which the artist truly convinced his relatives about his artistic talent and the novelty of his artistic choices. With joy and relief Souza-Cardoso wrote to his fiancée: *My father is extremely happy with me. The book of St. Julien has marvelled us*[79].

As referred by José-Augusto França, the "heraldic fantasy" present in the previous work of twenty drawings is the same that surrounded the hard work of illustration of this tick manuscript. This author underlined that Amadeo's passion for the Flemish «gothic» painters is related with the idea of illustrating a tale about a medieval saint [França 2004, 26]. Catherine Grenier, director of the Foundation Alberto and Annette Giacometti in Paris, presents "Medievalism" in the early 20th century and the so called "primitive art" and folk art as sources of inspiration for the *avant-garde* artists of that time [Grenier 2016, 28]. Thus, in this surprising work – *La Légende*, the Portuguese artist copied and illustrated the tale on Saint Julian the Hospitaller like a medieval monk, with the same patience and rigour. Moreover, the decorative elements, illustrations, and text link each other gracefully and this result brings about a modern reinterpretation of a Medieval Codex[80].

The tale itself has many particularities that fired up Amadeo de Souza-Cardoso, as the heraldic, medieval and fantastic ambience. In José-Augusto França's words: *its hero was a young hunter, who would*

[79]From a letter by Amadeo from Manhufe to Lucie (December 24, 1912) [apud Alfaro 2007, 164] (Translation by the author of this dissertation).

[80]This will be discussed with more detail in *Chapter 2, section 2.3.*

be the celebrated condottiere and fiancé of the emperor's daughter. He would be brought down in disgrace, but at the end of his life, sanctified by it[81] [França 2011, 183].

Helena de Freitas referred that this work is, as well, one of those that best reveals Souza--Cardoso's personality[82]. In one hand, just like for Gustave Flaubert, this tale seems to have a kind of autobiographic effect on the young painter. In Amadeo's case, Freitas observed that we can imagine him in the role of Julian as *swift rider*, as *hunter with greyhounds and falcons in his mountains in Manhufe*. He himself described to Lucie his house in Portugal as a castle on the top of the mountains: *type of a castle resembling someone who watches over the mountains at its feet*[83] (***Figure 1.18***). The description made by the artist refers to an aristocratic and medievalist imaginary. Besides, the author also mentioned that the Portuguese painter Amadeo de Souza-Cardoso was known in Paris by his *aloofness and haughtiness*[84] [Freitas 2006, 33].

Figure 1.18. *On the left:* Amadeo de Souza-Cardoso's house in Manhufe;
On the right: Postcard of the house of Manhufe, BA-FCG.

The art historian and critic João Pinharanda noted that this vision of the artist about himself is a result of his *basic family upbringing, social and political as well as regional and national influences: owner of wealthy farm, of aristocratic pretensions, and a strong believer of Monarchy and Catholicism with a strong sentimental connection to the Nation*[85] [Pinharanda 2009, 32].

António Rodrigues, another art historian and critic, also alluded that the emblematic image of the rider that Amadeo used, especially in the early years of his career – as *La Légende* is an example – is result of a *galloping emotion for life itself*. It does not aim to portray a *futurist representation of a body*

[81]Translation by the author of this dissertation.
[82]Cf. also Damásio, L.P.C. *A galeria de Amadeo. Vida pintada. Subsídios biográficos*. PhD dissertation. Porto: FLUP, 2016.
[83]Letter by Amadeo from Manhufe to Lucie 1910 [apud Freitas 2008, 23] (Translation by the author of this dissertation).
[84]For example, citing José-Augusto França: *Was Amadeo being pretentious, as his friends found him, when he wore a 'tuxedo', announcing to them that he was dining 'en ville? Or when he used a magnificent 'Alentejano' cape, the only one in Paris? It was, according to him, worn in his country only by noblemen. Amadeo had his reasons, and proudly believed they were justified – Rastignac from Manhufe out to conquer the big city. And who knew he wouldn't?* [França 1999, 29].
[85]Translation by the author of this dissertation.

in movement but *the expression of a state of spirit*[86] [Rodrigues 1987, 24]. As also mentioned by this author:

> *The spirit of a modern man, being Amadeo himself identified with the legendary figure of the rider, of a hardworking man, full of value and spunk, valiant, paladin and lover of a strong and warrior spirit, arrogant, hard and fierce – the knight who in order to become famous went in search of righteous adventures, fighting in 'tournaments' of painting, which is the course of the life of knight Amadeo*[87] [Rodrigues 1987, 24].

On the other hand, Helena de Freitas noticed that in *La Légende* it is clearly observable that the artist was searching for a graphic identity[88] [Freitas 2008, 22]. As previously referred, Amadeo's oeuvre is a very particular case since it is characterised as being *a river with multiple affluents*[89], i.e. it flows in various directions*.* The art historian Emídio Rosa de Oliveira pointed out that the modernity of Souza--Cardoso's painting results from a *multiplicity of styles and a feverish simultaneity which wants to try everything* [Oliveira 1992, 19]. Pedro Lapa observed that the work of the artist is sensitive to all modernist currents but *heterodox* in the relationship with them which had *extremely purist principles* [Lapa 1999, 101]. In fact, as also mentioned by the German art historian Joachim Heusinger von Waldegg, the *eclecticism* present in Amadeo de Souza-Cardoso's work is the reason why he is also called *the Chameleon of Amarante* [Waldegg 2006, 379]. Moreover, according to this author, *La Légende de Saint Julien l'Hospitalier* is a *paradigmatic example* of a certain *private mannerism*, which in the modern art context, is related with *phenomena of exchange of forms, mixture of styles and inversion* that are patently in this manuscript [Waldegg 2006, 381]. It is also evinced that its creative process is allied to a constant conceptual evolution that can be assumed as "metamorphosis". *La Légende* presents the many different traits of Souza-Cardoso himself, defining the painter as having a multiple identity [Waldegg 2006, 383]. This was the way how he understood modernity and, strangely, after his time in Paris (between 1914 and the artist's death in 1918) still his personal way of working [Lapa 1999, 102].

Waldegg also pointed out that the close friendship established between Otto Freundlich and the Portuguese painter in Paris, during the summer of 1912, brought consequences that are reflected in the production of the manuscript: Firstly, the affinity with the German Expressionism by both artists. In which concerns Amadeo, it is revealed in the way by which the artist is able to illustrate *the fantastic sense and the paradoxical state of the soul characterised by Gustave Flaubert* [Waldegg 2006, 385]. Secondly, they had in common the interest for Romanticism. For Amadeo "it is the nocturnal side, the morbid, the grotesque, the fantastic, in conclusion *black Romanticism* that led him to illustrate a Flaubert's tale [Waldegg 2006, 393]. Finally, another common interest was the *Jugendstil* (and *Art Nouveau*) that intended to *reform the decorative arts and the renovation of the way of facing handiwork*. So, here the artist found the *roots for the art of illustration* [Waldegg 2006, 393].

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[86] *Idem*.
[87] Translation by the author of this dissertation.
[88] This subject will be discussed in more detail in *Chapter 2, section 2.1*.
[89] Cf. Freitas 2008, 19 (Translation by the author of this dissertation).

The album *XX Dessins* and *La Légende de Saint Julien l'Hospitalier* have also in common, the fusion between *literary* and *decorative* elements from the modernist language, far from the stiffness of Cubism but connected with a certain orientalism, the Gothicism revivalist and the African art [Pinharanda 2009, 33]. José-Augusto França also alluded to a reference to the dancers of the *Ballets Russes* of Diaghilev, especially in a representation of Julian [*see* p. 27 in ***Appendix A1.1***] [França 1972, 29].

According to Waldegg, Amadeo's manuscript already presents certain dialogue with the expressionist group *Der Blaue Reiter* also keen on the renovation of arts [Waldegg 2006, 395]. Actually, it was in May 1912 that they published the famous almanac that the Portuguese painter eventually read. Amadeo and those artists show in common the interest for the folk art and the "Primitivism" of which *La Légende* is also an example[90]. Another affinity to this group is the theme of the rider [Waldegg 2006, 395]. Through the network of contacts of Sonia and Robert Delaunay in Paris – or even Freundlich himself – Amadeo met Franz Marc and August Macke [Alfaro 2010, 32]. Curiously, in 1913, Marc painted one of his riders in a work entitled *Saint Julian the Hospitaller* (***Figure 1.19***).

Figure 1.19. Franz Marc, *Saint Julian the Hospitaller* (1913). Source: Solomon Guggenheim Museum, New York website: www.guggenheim.com

After *La Légende*, Amadeo's *aristocratic taste*[91] led him to the creation of other works related with medieval castles and riders[92]. Maria Filomena Molder and Javier Arnaldo have noted that the artist produced the oil painting *Le Prince et la Maute* (1912) [The Prince and the Pack] basing on an illustration from the manuscript [*see* p. 30 in ***Appendix A1.1*** and ***Appendix A1.4***] [Molder 2006, 15; Arnaldo 2009]. According to França, in the painting *Procissão Corpus Christi* (1913) [Corpus Christi Procession] the representation of Saint Georges can be assumed as a caricature of Saint Julian [França 2011, 188]. One of the descendants of *La Légende* was the painting *Cavalier* (1912) [Rider], with a new aesthetic language, that caught the attention of Walter Pach, opening to Amadeo de Souza-Cardoso the doors of his career to a transatlantic experience achieved with the participation in the *Armory Show* in 1913 in USA [França 1999, 37; Gonçalves 2006, 19] [*see* ***Appendix A1.4***].

La Légende de Saint Julien l'Hospitalier definitely marked *the arrival of the artist and the driving force to a new direction* [Freitas 2006, 34].

[90]This subject will be discussed in more detail in *Chapter 2, section 2.3*.
[91]Expression by José-Augusto França [Cf. França 2011, 180].
[92]Cf. Freitas 2008b, 164-176.

La beauté sauverá le monde[93].

Fiodor Dostoïevski from *The Idiot* (1869)

CHAPTER 2: A modernist codex: *La Légende de Saint Julien l'Hospitalier*

2.1 The *facsimile* editions

Before the exhibition *Diálogo de Vanguardas* [*Avant-Garde* Dialogues] (2006), the manuscript by Amadeo de Souza-Cardoso, *La Légende de Saint Julien l'Hospitalier*, was unknown to the general public. In fact, up to 2006, this work was shown in a few exhibitions: in 1916, in Porto and in Lisbon, probably also in 1925 on the occasion of the first posthumous exhibition of the artist held in Paris and later in 1956, 1958 and in 1999 at *Fundação Calouste Gulbenkian* (FCG)[94]. As it is not possible to access all pages of a manuscript when it is displayed at the museum[95], where only two pages can be shown, the FCG's idea of creating a *facsimile* edition of *La Légende* (***Figure 2.1***) came at the right time. It is now easier to admire Amadeo's work (143 pages), although it cannot obviously substitute the original piece. With more precision, there are two different copies of the *facsimile* edition - a version with dimensions close to the real manuscript (deluxe version) and a smaller version (normal version). For each of them, the essayist Maria Filomena Molder wrote a different essay. Since these two essays represent the most complete analysis of Amadeo's *La Légende* until the present date, the insertion of a critical review on these texts is fundamental in the framework of the present dissertation.

Figure 2.1. *Facsimile* edition of *La Légende de Saint Julien l'Hospitalier*.

[93]Translation: Beauty will save the world.
[94]Information obtained from the MG-MC registers.
[95]For conservation issues, the manuscript stills, usually, in the storage of MG-MC.

2.1.1 Synopsis of *La Légende de Saint Julien l'Hospitalier* by Flaubert

Prologue to the critical review of Maria Filomema Molder's essays [*see **section 2.1.2***][96].

Figure 2.2. Episode of the parricide committed by Julien. Masaccio, *Stories of St Julian and St. Nicholas* (1426) (detail). Source: Gemäldegalerie (Berlin) website: http://www.smb.museum/home.html

Julien is the son of a lord of a castle. After his birth, each of his parents received a different prophecy that they kept in secret. His mother was visited by the vision of a hermit who announced that Julien would become a saint. On the other hand his father was told by a gypsy beggar that his son would become a great conqueror.

From his childhood days, Julien shows a savage spirit and primitive ferocity. He is passionate on hunting and he kills any animal without mercy. However, everything changes when he violently hurts a deer that prophesied that his obstinate spirit will lead him to murder his own parents. Tormented by such words, he runs away from home. Julien becomes a valiant and famous combatant. He helps the emperor of Occitania in a war who gratefully, offers him the hand of his lovely daughter and a great palace. However, no luxury is enough to calm Julien's restless spirit. After a long time, he succumbs to the temptation and goes hunting one night. Shortly thereafter, Julien's wife receives the visit of an elderly couple that has come to look for their son. She gives them the comfort of her own bed to rest. The animals of the forest seem to conspire against Julien but nothing happens. When he returns home in the early morning after a restless night, he sees two bodies sleeping in his bed. Suddenly, he kills them with his sword thinking he has caught his wife in an adulterous act (***Figure 2.2***). However when his wife comes in the room with a torch in her hand, the tremendous words of the deer come gushing into Julien's mind.

To redeem his sin, Julien decides to start a life of solitude, penitence, poverty and humiliation. The temptation to commit suicide occurs to him constantly. He becomes boatman and helps people to cross a dangerous river. Profoundly sad, one night, Julien hears a voice calling out his name across the river. He rows his boat towards the voice and finds a Leper, who gives him a big hug. Actually, it is Jesus Christ who has come to take *the Hospitaller* to Heaven. Julien's sin has been forgiven because of his repentance.

[96]Cf. Flaubert 2005 (Portuguese version consulted).

2.1.2 Critical review of the essays

- **Molder, Maria Filomena, *Amadeo de Souza-Cardoso, La Légende de Saint Julien l'Hospitalier de Flaubert* (*Facsimile* edition), Lisbon, Centro de Arte Moderna José Azeredo Perdigão, Fundação Calouste Gulbenkian, 2006, p.11-50. ISBN 978-972-635-183-2 (<u>deluxe edition</u>).**

This essay, entitled *'La Légende de Saint Julien l'Hospitalier' de Flaubert e Amadeo de Souza--Cardoso*[97], was written by Maria Filomena Molder and published in the first part of the deluxe *facsimiled* version of Amadeo's manuscript. This forty-two-page text, together with the essay for the normal facsimiled version (discussed below) has became, since the exhibition *Diálogo de Vanguardas* [*Avant-Garde* dialogues] (2006), the reference documents *par excellence* concerning *La Légende*. It is organised in seven parts and provides a more direct understanding of Gustave Flaubert's tale - the context in which it was written, the importance of the production of Amadeo's manuscript in the Portuguese painter's career and finally, also reveals some of the sources that inspired him in the accomplishment of this work. The latter topic constituted the starting point for the development of the research presented in ***section 2.3*** of this dissertation.

Maria Filomena Molder (b.1950) is specialist in the areas of Aesthetics, Morphology and Philosophy of language. Since 1984, Molder is the author of several essays for catalogues and other texts concerning Art and Portuguese and foreigner artists. Her critical research on Amadeo's *La Légende de Saint Julien l'Hospitalier* and the study *Diálogo de Vanguardas* carried out by Helena de Freitas were awarded the José de Figueiredo Prize from the Portuguese *Academia Nacional de Belas-Artes* in 2007.

The first of the seven parts of this essay is devoted to the characterisation of Julien, the main character of the tale. This long-awaited son since early age revealed abomination for docility and *avidity for destruction* [Molder 2006b, 13]. During his youth, the author defined him, in a first moment, as the *damned hunter*, cruel and sadistic (the animalistic side of the human being) [Molder 2006b, 11-15]. Beyond the referred Goethe's vision of nature as a *force that devours force*, Molder clarifies that:

> *[Julien] wants to be more goat than the goat itself, more wolf than the wolves themselves, he wants to overcome the mere condition of being a survivor to be a pure, purpose-free force. A falcon, undisturbed, obsessive, and ascetical: to rise into the sky, to swiftly drop, to swoop upon its prey, catch it, dilacerate it, to render it to nothing and then return to its lord's gauntlet* [Molder 2006b, 367].

In Julien lives a devastating absence of compassion [Molder 2006b, 15].

However, in a second moment, during the night that precedes the parricide, Molder defines Julien as the *hunter who becomes the game*, impotent before the threat of the animals of the forest and is close to experiment the metamorphosis of his violent impulses [Molder 2006, 11]. The author praises the way how Amadeo illustrated this stage of the tale: *beasts' faces appear, threatening, with intimidating gazes*

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[97]Translation: *La Légende de Saint Julien l'Hospitalier* by Flaubert and Amadeo de Souza-Cardoso.

of malicious gestures. The hunter is nowhere to be seen, which revels a sublime understanding of Flaubert's oeuvre [Molder 2006b, 370].

As referred by Molder, the destructive avidity only finds an end with the annihilation of his parents [Molder 2006b, 16]. It would only find peace in the *rough, cold skin of the leper* [Molder 2006b, 372].

Holiness is the theme of the second part of this essay. Molder points out that Gustave Flaubert, as well as the writers Rilke or Sebald – some of his most notable readers – considered that there is a connection between holiness and cruelty. According to the latter, the author refers that these two opposite forces dilacerated Julien's heart [Molder 2006b, 19]. The author also alluds that Manuel Laranjeira (Amadeo's friend) defended a thesis in Medicine entitled *A doença da santidade. Interpretação psicológica do misticismo* [A Psychological Interpretation of Mysticism – The Disease of Sanctity], relating excess, aberration and holiness and indicated that Amadeo owned this thesis in his personal library[98]. The writer Thomas Mann and the philosopher and poet Nietzsche are also referred as having assumed that holiness is fruit of family disruption, in particular, from incest [Molder 2006b, 19]. Nevertheless, Molder makes it clear that this is not the case in Saint Julian's story. His holiness was provided by the double parricide. In fact, that was the moment of his conversion, when the *damned hunter*, finally, falls into himself and changes his desire from killing to dying. The horror of his parents' death chaises him until his last day [Molder 2006b, 20]. Nevertheless, the purpose of expiation of his sin will be totally accomplished through the redemption of the Leper [Molder 2006b, 22].

Metamorphosis is the keyword of the third part of Molder's essay. According to Wassily Kandinsky, referring to the *Principle of inner need*, every artist, as a creator, has something in him, which calls for expression (this is the element of personality) [Kandinsky 2002, 73]. In fact, Molder proposed a justification for the production of the manuscript *La Légende de Saint Julien l'Hospitalier* by Souza-Cardoso. It is mentioned that the artist used to suffer strong anguish and swings of mood (*I have got more phases than has the moon*[99]) associated with the affirmation of his artistic identity [Molder 2006b, 375]. This fact was revealed in his calligraphy especially from 1912 (different sizes of the letters, drawings, and inclinations) as observable in his letters [Molder 2006b, 23]. As consequence of this fact, Maria Filomena Molder proposes that the calligraphic copy of Flaubert's tale was a discipline exercise of homogeneous handwriting which Amadeo imposed to himself as an instrument of metamorphosis [Molder 2006b, 23]. Actually, it can be assumed in the perspective of the German essayist Walter Benjamin:

> *(…) the power of a text is different when it is read from when it is copied out. Only the copied text thus commands the soul of him who is occupied with it, whereas the mere reader never discovers the new aspects of his inner self that are opened by the text, that road cut through the interior jungle forever closing behind it:*

[98]This exemplary is present in Amadeo's estate at BA-FCG. In the first pages of the book it is visible a dedication from Laranjeira to Amadeo: *Ao Amadeu Cardoso – ao amigo e ao artista. Manuel Laranjeira, Março 1907* [To Amadeu Cardoso – friend and artist. Manuel Laranjeira, March 1907].

[99]From a letter from Amadeo to Lucie dated 1910 [apud Molder 2006b, 22].

because the reader follows the movement of his mind in the free flight of day-dreaming, whereas the copier submits it to command[100] [Benjamin 2004].

In the context of Amadeo's oeuvre, *La Légende* presents itself as "preliminary work" for the relation between word and image, also established in some of his later works such as *A ascensão do quadrado verde e a mulher do violino* (c. 1916) or *Canção d'açude poema em cor* (c. 1915-1916)[101].

Quoting Rainer Maria Rilke in *The notebooks of Malte Laurids Brigge* - *it is me who is going to be written*. Molder applied these same words to Amadeo referring that this exercise produced also an admirable hermeneutic effect. Actually, the way how the artist decided to organize the text provided elements for the illustration itself [Molder 2006b, 376]. Another referred aspect related to artist's emotional instability is the multiplicity of signatures used by himself until 1912 [*see* ***Appendix A2.1***].

Maria Filomena Molder pointed out that this fact is an expression of an identity issue. In fact, in that period, Amadeo was using the falcon as his *totem* and an emblem composed by two falcons and a scorpion (his Zodiac sign) as signature especially on his *XX Dessins* [*see* ***Appendix A2.1***] [Molder 2006b, 25]. Knowing this background, Molder indicates that the Portuguese artist gave special emphasis to the presence of this fowl in the illustration – more than Flaubert did – which is present in all Julien's metamorphosis (conversion) process [Molder 2006b, 24]. Moreover, the author observes, that from 1914, Amadeo ceased to represent animals, choosing instead for architectural shapes, masks and collages, as fruit of his own artistic metamorphosis associated to his continuous *restlessness of identity*. Besides, the interest to copy and illustrate the story of Saint Julian which can well be justified as a certain *attraction for blood crime* and can be exemplified in some of his following works. In short, according to Maria Filomena Molder, *La Légende de Saint Julien l'Hospitalier* can be seen as an instrument of *purification and liberation* for the artist [Molder 2006b, 25].

A parallelism between Flaubert and Amadeo is established in the fourth part of this essay. The author points out that both writer and painter had in common the feeling of not belonging anywhere and the pain associated with that [Molder 2006b, 29]. Moreover, the author quotes a letter by Amadeo to his uncle Francisco where he stated: *You feel the pain but it does not show* and, in addition, the joyful paradox: *Man is not a shell fish nor the soul a parasite. May the expression of art be an intense presence, a proof of culture and joy of life*[102]. Molder notes that also Julien was surrounded by different "existences". After, getting married, Julien fights against the temptation of hunting. The author also alludes to the episode in which Julien dreamed being Adam and killed each animal presented to him [Molder 2006b, 30].

In the fifth part, Molder states that Gustave Flaubert abhorred the idea of any illustration of his works. Nevertheless, basing on the reflection of the poet and translator Marina Tsvetaeva, Molder refers that in the case of the Portuguese artist the verb "to illustrate" can be interpreted according to the German translation *Wie ich es sehe* [as I see]. In fact, once again, the author points out that *the mystery of*

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[100]Translation by the author of this dissertation. Cf. Molder 2016, 35.
[101]Cf. AA.VV. Exhibition Catalogue Amadeo de Souza-Cardoso 2016-1916 Porto-Lisboa, 165-271.
[102]From a letter from Amadeo to his uncle Francisco dated 1912 [apud Molder 2006b, 383].

Amadeo's illustration is inherent to the unfaltering, full copy of 'La Légende', with rightful, not occasional, choices, fully validating the interruptions of the text in each page bring to light decisive facts to it, even elucidating the very text's interpretation [Molder 2006b, 384]. For instance, Amadeo represented the father and mother of Julien, after the parricide, as two symmetric falcons *restored to their animal condition, which lies in depth within Julien, but that Flaubert does not explicitly pursue* [Molder 2006b, 385].

Kandinsky referred that *Word is an inner sound* [Kandinsky 2002, 41]. In *La Légende*, this sentence is clear, namely in the way how letters, as whirlwinds, are inscribed around the text's frame in a disruptive continuity as stuttering the saint's name. Molder notes that a similar resource was applied by the artist in *L'Athlète* (1913) [Molder 2006b, 33].

Accomplir c'est vaincre [winning is accomplishment] was Amadeo's motto at the time – present in his *ex-libris* from the album *XX Dessins* – was based in the motto present in an ancient flag from Brittany [*see* ***Appendix A2.1***]***.*** It reveals that besides his anxiety the artist's was aware that life gave him *a destiny to fulfil*. This ideal will be the "raw material" for the many metamorphoses of his artistic life [Molder 2006b, 386]. According to the author, this feeling mirrors the artist's interest for religious spirituality and theological readings (namely the *Confessions* of Saint Augustine). Moreover, as mentioned by Molder, around the work *L'Athlète*, Amadeo incrusted some sentences from the biblical book *Song of Songs* [Molder 2006b, 36].

In the sixth part, Maria Filomena Molder presents some considerations regarding the illustration of *La Légende*. The author alluded to Amadeo's skin disease[103] (since 1906) and considered the emblem of the *XX Dessins* as a sort of *tattoo* that is overspread along the illustration of the manuscript [Molder 2006b, 39]. For this reason, according to Molder, the artist was sensible to the Leper character of Flaubert's tale and found an association between him and the decoration of the manuscript. In fact, the Leper represents another vision of Christ's metamorphosis power [Molder 2006b, 40]. Concerning the decorative elements, the author notes that Souza-Cardoso mainly used an anti-figurative ornamentation, specially alluding to falcons but also to serpents. Some figurative elements such as some animals were introduced from Flaubert's words [Molder 2006b, 40]. The manuscript shows a mixture of many formal elements [Molder 2006b, 41]. Furthermore, the author also refers that the *writing obedience* that Amadeo followed as a copyist medieval monk, reveals, as well, a certain contemplative value. In fact, the artist's brushstrokes will express something more than a mere illustration (in Flaubert's repulsive sense). Molder also defends that *La Légende* exceeded the text and anteceded the use of the *pochoir*[104] [*see* ***Appendix A2.1***] by the painter in 1914, in the dialogue between text and image [Molder 2006b, 41].

Finally, in the seventh and last part, the author refers that Amadeo, as any other artist, did not produce his work aiming for an interpretation and cites Louis Bourgeous that stated: *Rigourously, Art has nothing to do with the history of historians, but it has everything to do with life* [Molder 2006b, 43].

[103] Cf. Travassos *et al*. 2014.
[104] This French term refers to painting through a stencil.

As a matter of fact, the Portuguese artist was only interested in his artistic evolution, in *suffering the consequences of his setbacks, to confirm his affinities, and to rejoice with his findings* [Molder 2006b, 394]. Molder indicates that the dynamism of his work led him to gather diverse opinions and mix old techniques with those that were contemporary to the artist, without imitating anyone. This was the essence of Amadeo's simultaneity [Molder 2006b, 44]. The artist was interested in the ancient and in the new; in the works of the Flemish "primitives" as in Robert Delaunay's discs. Maria Filomena Molder points here also the importance of the book *L'Évolution Creatrice* by Henri Bergson that the Portuguese artist acquired in 1907 [Molder 2006b, 45].

The author observes that from 1914, Amadeo started signing his works using the *pochoir* influenced by the couple Delaunay, as solution for his inconstant signature. It became a sort of new mask for the artist, after the emblem for the *XX Dessins*. Coincidentally, in this same period, the Portuguese artist ceased to represent the falcon in his works. Molder observes that it doesn't mean that it has disappeared. It simply suffered a metamorphosis in other elements used by the artist all through his career [Molder 2006b, 46]. According to the author, *La Légende* does not find meeting points with the *Art Nouveau*, the *Jugendstil* or with Aubrey Beardsley's works [Molder 2006b, 48]. The illustration of Julien's metamorphoses was represented inspired by the *Ballets Russes* (Nijinsky in *L'Après midi d'une faune*), Henri Rousseau and his mysterious forest, the Flemish "primitives", the coats of arms of Brittany, the medieval representations on *Château de Keriolet* tapestries, the book of Japanese printed images, the African masks, the hunting scenes represented by Paolo Uccello (*Battaglia di San Romano*)[105] and the representation of the Portuguese fishmongers were the sources identified by the author where Amadeo de Souza-Cardoso found inspiration for his illustration [Molder 2006b, 49]. Despite his reluctance concerning illustration, Maria Filomena Molder concluded that the modernism of Amadeo de Souza-Cardoso's *La Légende de Saint Julien l'Hospitalier* would have surprised Flaubert [Molder 2006b, 50].

- **Molder, Maria Filomena, *Amadeo de Souza-Cardoso, La Légende de Saint Julien l'Hospitalier de Flaubert* (*Facsimile* edition), Lisbon, Centro de Arte Moderna José Azeredo Perdigão, Fundação Calouste Gulbenkian, 2006, p.11-50. ISBN 978-972-635-184-9 (<u>normal edition</u>).**

Maria Filomena Molder entitled this second essay as *Descriptive memory of the handwritten copy and illustration of La Légende de Saint Julien l'Hospitalier* which presents a methodology of a more concise work respecting the previous essay presented. This text provides a panoramic vision of Amadeo's *La Légende*, contextualised in the course of the artist's career in the years 1911-1912. In it, the Souza-Cardoso's handwritten work is highlighted. In it, it is possible to recognise the rigour and taste for harmony of a medieval monk. On the other hand, the evidence of the fact that it was done from the tale of

[105]As will be seen in *section 2.3* these hunting scenes seem to be related to other influences.

Gustave Flaubert, in French, without errors or hesitations reveals the artist's familiarity with the text and great *hermeneutic capacity*, a fact that acknowledges vigour to the words of the French writer [Molder 2006, 16]. Here, the author praises Amadeo's geniality expressed in the way how he organised the text (sometimes not respecting the beginning of a paragraph) and his comprehension of Flaubert's words that gives the reader a new understanding of the tale [Molder 2006, 17].

Starting from the formal organization of the manuscript, Maria Filomena Molder indicates three main parts. The first part includes the cover with the title, frontispieces and initial pages. The second is denominated synopsis, composed by images where the characters and sequence of Flaubert's tale are presented. Finally, the third part regards the illustration of the tale itself.

Page after page, the author, awakes the reader to its diverse particularities. Molder notices that the title was drawn with the same colour of the *heavy drops of blood* represented on the page that narrates the parricide [*see* p. 117 in ***Appendix A1.1***] [Molder 2006, 13]. Besides that the author also refers to the *rhythmic flow* and the way it was written is observable in key moments of the illustration. The important role of the falcon in Amadeo's illustration is emphasised. The author calls attention to the gold circles with black core that Amadeo de Souza-Cardoso used as dividers of the book and by comparison with other works of the artist (1911-1912), associated them with the eyes of a falcon [Molder 2006, 14]. Actually, the artist always represented Julien with elements that are related with this fowl (feathers and claws) [Molder 2006, 22]. In the illustration of the tale, after the parricide, the artist also represented the father and the mother of Julien as two falcons [*see* p. 119 in ***Appendix A1.1***] which found a parallelism in a previous representation of two swords [*see* p. 88 in ***Appendix A1.1***] [Molder 2006, 31]. It is also referred that in comparison to his previous work – the album *XX Dessins* – *La Légende de Saint Julien l'Hospitalier* is also well immersed in the medieval atmosphere but in this case, the artist gave more emphasis to the falcon, which representation overcomes that one in that album [Molder 2006, 19]. It is also observed that the emblem used in these drawings as signature, as referred in the previous text, alludes to the representation of the falcon and it is connected with Amadeo's identity issues. Note that this illustration of the falcon is observable in other pages of *La Légende*. Molder refers the signature of the artist (ASC) used in the synopsis, graphically finds meeting points with the monogram (SJH) present in the initial pages of the book [Molder 2006, 14].

The mechanism of the metamorphosis of the saint is disclosed by the author. In Amadeo's illustration two main ways are announced. Firstly, in the representation of rhythmic flows (as the case of the title is an example) which evolution converges to the name of the saint through the illustration [*see* evolution in p. 57, 59, 62, 107 and 109 in ***Appendix A1.1***]. Secondly, through geometrical elements (small circles, stars, moons and hearts) which converge into the image of the falcon [*see* evolution in p. 60, 97, 103, 104 and 105 in ***Appendix A1.1***]. These two resources pointed out the clear connection between text and painting and the emotion expressed by the artist with the evocation of the saint's identity. The idea of metamorphosis is also expressed in the way how Amadeo de

Souza-Cardoso represented the human body, using the graphical resource of deconstruction [*see* e.g. p. 21, 33 and 45 in ***Appendix A1.1***]. Moreover, the representation of Julien's mother (p.21) and father (p.33 – actually, Julien with the appearance of his father) presents a metamorphosis between background and the surface of the drawing (alluding to the parricide).

It is also mentioned in this essay, that the Portuguese artist introduced in the illustration, other elements from the *XX Dessins*. Example of this is the emblem from those drawings which was transformed in a heraldic symbol in one of the frontispieces of *La Légende de Saint Julien l'Hospitalier* [Molder 2006, 13]. Another reference to that work is the representation of the castles in a similar way to the *ex-libris* [*see* p. 27 and 51 in ***Appendix A1.1***] [Molder 2006, 14]. Furthermore, the representation of the African tribal masks (here represented in connection with Julien's animality) reminds the emblem from the *XX Dessins* [*see* p. 62 in ***Appendix A1.1***] and the re-introduction of the chess table from *Mauresques* and *Sur la terrasse* [*see* p. 125] find meeting points, as well as, with that in the album of drawings [Molder 2006, 43]. Some pages of the synopsis were illustrated resembling tapestries[106] [Molder 2006, 14].

Molder observes that Amadeo de Souza-Cardoso used elements from the coats of arms of several cities of Brittany as decorative elements [Molder 2006, 21]. As result it is possible to observe in many pages of *La Légende de Saint Julien l'Hospitalier* the representation of weapons, animals, geometric elements, flowers, crosses, castles, boats which result from the dismemberment of the referred coat of arms. It is also mentioned that Amadeo gave special attention to the representation of some animals in comparison with their reference in the tale. Besides the falcon, the presence of the serpent is constant (Molder associates it to the metamorphosis) [Molder 2006, 20]. The deer is determinant with its terrible prophecy [Molder 2006, 30]. The artist also represented other animals such as insects, weasels, fish, owls and peacocks. All of them predict the metamorphosis of the hunter. In addition to the influences referred in the previous essay, here, Molder mentions the Japanese printed drawing by which representation of the weasel Amadeo seems to have been inspired[107] [Molder 2006, 35]. Finally, the essay refers to some drawings from *La Légende* which were precursors of Amadeo's paintings. Example of that are *Le prince et la maute* (with a rhythmic element present) and also *Procession of Corpus Christi* (the representation of the rider) find similarities with the drawing of Julien dead [*see* p. 45 in ***Appendix A1.1*** and ***Appendix A1.4***] [Molder 2006, 15-16].

The new vision on the manuscript *La Légende de Saint Julien L'Hospitalier* by Amadeo de Souza--Cardoso provided by Maria Filomena Molder in these two essays reveals a precious first contribution for the better knowledge of this work of the Portuguese painter in complementation with the topics referred in ***Chapter 1*** **(*section 1.3.1*)** of this dissertation. In fact, *La Légende* was not a mere work that Amadeo carried out freely during the summer holidays spent in Brittany. Molder proposes plausible reasons behind

[106]Cf. Jérôme Doucet's preface for the album *XX Dessins* [Doucet 1986].
[107]In *section 2.3* another influence is suggested.

the production of this book revealing it like no one has ever done before. In this important study, the author permitted by *metamorphosis*, to encounter the keyword of both the path of Julien from fierce hunter to the crown of sanctity, narrated by Flaubert, and the proper essence of understanding the tale by Amadeo who reveals it through the copy and illustration of the same. Nevertheless, the term "illustration" is limited in respect to the work carried out by Souza-Cardoso. If the young artist revealed *great hermeneutic capacity* in relation to Flaubert's tale through this piece of work, Molder also discloses it in relation to the work of the Portuguese artist, realising that the artistic disquietude experienced in relation to his identity is the key to the conception of this work. These same disquietudes exposed, explain the production of this singular book in the panorama of his artistic works: Amadeo himself became the object of metamorphosis during its conception. The vision offered thus allows the confirmation of the positioning of *La Légende* as the culminating work of the end of his early career, revealing as a corner stone for a new artistic path where the artist adopts new elements (the metamorphosis of the falcon, referred by Molder). In fact, a constant thirst of originality that accompanies the work of Amadeo until the end of his career is mirrored in continuous change of languages and styles. The change in moods – as revealed in his letters – also accompanies him. Furthermore, the problem with his signatures was not totally solved by resorting to the *pochoir* as a mask. The ultimate work of Amadeo *Sacred Heart of Jesus* [*see* ***Appendix A1.4***] from the year of his death – 1918 – presents a similar signature to the monogram "SJH" which appears on the first pages of the manuscript. *Metamorphosis* definitely is revealed as the key of *La Légende* (expressing the conversion process of Julien), as well as – it can be said – of the whole painting of the Portuguese artist.

Finally, as mentioned by the curator and philosopher Paulo Pires do Vale, *an essay (…) is a text that exploits an object by attempts (…) without the intention of discussing a methodical and conclusive thesis. The essay, instead of being conclusive is precisely, "declusive"; it avoids the wish of a conclusion*[108] [Pires do Vale 2012, 11]. In continuation of Maria Filomena Molder's work, in the following ***sections 2.2*** and ***2.3***, the results of the research that allow to place *La Légende* in the panorama of the Portuguese and international artist's books of the early 20th century and the identification of other sources that inspired the artist, namely, how and how much the dialogue between modernism and the medieval illuminated codicies influenced Amadeo in the production of this manuscript aiming providing new perspectives on *La Légende de Saint Julien L'Hospitalier*.

2.2 Amadeo's artist's book

This section deals with the study of the inclusion of *La Légende de Saint Julien l'Hospitalier* in the framework of the universe of the artists' books production from the early 20th century. For this purpose, a data-set of artist's books was collected aiming to compare them with Amadeo's manuscript.

[108]Translation by the author of this dissertation.

From a young age, Amadeo nourished a passion for reading and used to spend time at the private library of his uncle Francisco at *Casa do Ribeiro*[109] [Ferreira 1987, 11]. Most certainly, he first met Gustave Flaubert's oeuvres in his readings there, as can be seen by the letter he wrote to his sister Helena from March 1907: *Enrico Pousada wrote to me saying that he had asked you for the 'Letters of Flaubert' which I believe are at [Casa do] Ribeiro, can you send them?*[110]. So, naturally, Flaubert was also one of the writers discussed during their gatherings at the *Café Chinez*. Therefore, it is not surprising to notice the informal way how Souza-Cardoso used the expression *flaubertian*[111] with Laranjeira.

Since 1908, Amadeo and Manuel Laranjeira were interest in creating a book in tandem. In a letter to Amadeo dated March 25, 1908, Laranjeira wrote: *Your idea of us carrying out a book in collaboration seduces me: We could do wonderful things. When I have more time I will put forward my ideas. I am sure that you will find them excellent*[112]. However, the project never came through. On February 22, 1912, Manuel Laranjeira committed suicide with a gunshot to the head at his house in Espinho [Alfaro 2007, 283]. Until that fateful day, Amadeo de Souza-Cardoso continued establishing an assiduous correspondence with this Portuguese friend [Alfaro 2007, 33].

After having visiting Amadeo's estate at BA-FCG, one can observe in the artist's personal library, the presence of the book by Laranjeira, *Commigo – versos de um solitário* [With me – verses from a solitary] (1911). According to the edition date, Amadeo bought it probably in 1912. A surprising fact is that Souza-Cardoso had his manuscript *La Légende de Saint Julien l'Hospitalier*, bound with the same creamy coloured binding material as *Commigo*. The latter had the insertion of the drawing of the emblem used in the *XX Dessins* on the cover[113] [*see* ***Appendix A2.1***]. This coincidence seems to establish a bridge between Amadeo's *La Légende* with the friendship with Manuel Laranjeira. As already referred in ***Chapter 1***, this friendship was of great importance at the beginning of Amadeo's career. Laranjeira was always encouraging and urged his friend *to draw, to draw a lot, to always draw*[114]. From this relationship it can be concluded that Souza-Cardoso has created *La Légende* in memory of his great friend who passed away precisely at the beginning of 1912, leaving an incomplete joint project to fulfil. However, Amadeo did not put aside this project and in the same year his characteristic *eagerness to create*[115] led him to plan his own artist's book.

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[109]It is located close to his parents' house in Manhufe. This uncle was a person versed in culture, graduated in Law, a traveler and friend of many artists and intellectuals of that time. He owned a rich personal library in this house, which walls were decorated with many pieces of art. The young Amadeo enjoyed going there [Ferreira 1987, 11].

[110]Letter from Amadeo to his sister Helena [apud Molder 2006b, 26] (Translation by the author of this dissertation). Note that, no exemplary of this book was found in Amadeo's estate at BA-FCG. Enrico Pousada was one of Souza-Cardoso's companions from the circle of friendships of Manuel Laranjeira [Cf. photograph presented in Alfaro 2007, 31].

[111]From a letter to Manuel Laranjeira from 1908: *(…) I, myself, disdain 'flaubertian' that I have in relation to the mediocrity, the same as I have for money (…)* [apud AA.VV. Exhibition Catalogue 1887-1987, 47] (Translation by the author of this dissertation).

[112]Letter from Manuel Laranjeira to Amadeo [apud Alfaro 2007, 288] (Translation by the author of this dissertation).

[113]From the comparison with other copies of the same edition of the book (Portuguese National Library and Library Fernando Pessoa in Lisbon), it is clear that it was Amadeo de Souza-Cardoso's choice to bind it in this way. As mentioned by Maria Filomena Molder that emblem was the artist's *totem* at that time [Molder 2006b, 23].

[114]From a letter from Manuel Laranjeira to Amadeo from October 23, 1907 [Laranjeira 1990, 79] (Translation by the author of this dissertation).

[115]Expression by the painter Paulo Ferreira [Cf. Ferreira 1987, 11] (Translation by the author of this dissertation).

2.2.1 The term *artist's book*

Paris, as the cultural and artistic center of the Western world, witnessed to the birth of the artists' books which crossed the major part of the "ism's" and became vehicles for artistic expression [Bury 2007, 8; Vale Pereira 2008, 17]. They became *the 20th century art form par excellence* (especially in the second half of the century), representing an important aspect of the French art of that period. However, they remained little known outside France [Strachan 1969, 17; Drucker 2004, 1].

As referred by Catarina Figueiredo Cardoso and Isabel Baraona, it is not easy to define the term *artist's book* and this subject has been extensively discussed by specialists as Anne Moeglin--Delcroix or Johanna Drucker. Nevertheless, according to Cardoso and Baraona, *there is a specific feature that distinguishes the artists' books from all other books – it is a book conceived as an object of art* [Cardoso and Baraona 2012]. The researcher Paulo Silveira adds that an artist's book is more than an illustrated book [Silveira 2008, 25]. Another definition indicates it *as an exhibition space for the artist's work that can be activated at any time by the person who manipulates it*[116]*.* Thus, it is an original object and not a reproduction of a preexisting work, designed as a unit [Melot 1984, 207; Drucker 2004, 2].

Silveira also quotes another specialist, Clive Phillpot from his *An ABC of Artists' Books Collections* (1982), who defines '*artist's book'* as a book in which the artist is the author of the work; '*bookwork'* as a piece of art dependent of the structure of a book and, *'art object book'* as an object of art that refers to the form of a book [Silveira 2008, 47]. As mentioned by Drucker: *Not every book made by an artist is an artist's book* [Drucker 2004, 9].

Since this dissertation deals with the case study of an early 20th century artists' books, the terminology followed was that indicated by the researcher Elza Adamowicz. This author presented the French term *livre d'artiste*[117] as synonym, designating the *various forms of the 20th century book in France (Paris) as collaboration between poets and painters or text and images*. Besides, Adamowicz also cited the author W.J. Strachan who uses this term to distinguish the 20th century artists' books from the earliest realizations and thus, associate it to the *École de Paris* [Adamowicz 2009]. The present study will only focus on their production until 1912, the year Amadeo created his own *livre d'artiste*.

2.2.2. *La Légende* in the context of the international productions until 1912

During the time Amadeo de Souza-Cardoso lived in Paris (1906-1914), traditional modes of communication and exhibition at the official *Salon* were denied to innovative artists of the *avant-garde* movements. Alternatively, manifestos, magazines, books and artists' books (*livres d'artiste*) were privileged

[116]Dupeyrat 2012 apud Cardoso and Baraona 2012.

[117]These books are also denominated as *livres de peintres* [Hofer 1982, 7]. The actual use of the term *artist's book* is more contemporary, first being used in the 80's. Elza Adamowicz clarified that in what refers to the *livre illustré* [book illustration], the priority is given to the text and the illustrator has the single mission of retelling the story through pictures [Blundell and Blanckaert 2001, 153; Adamowicz 2009].

means of dissemination of modernist artistic production[118] [Bury 2007, 8]. Just like in the case of Amadeo, such artists showed their works at rival exhibitions as the *Salon des Indépendants* and the *Salon d'Automne* or in private galleries [Bury 2007, 128].

When the 22 years old art dealer Daniel-Henry Kahnweiler set up his gallery in Paris (1907), he became the patron of several [future] cubist artists, as already mentioned in ***Chapter 1*****,** ***section 1.2***. Aiming at their artistic promotion, Kahnweiler started publishing *livres d'artiste* in 1909 under his own imprint [Starchan 1969, 36; Johnson and Stein 2001, 20; Bury 2007, 26]. He transformed the traditional illustrated book into *'la rencontre du peintre et du poète'* [119] [Adamowicz 2009]. According to the designer Jerry Kelly, it can be considered the best of both worlds [Kelly 2010, 20]. Drucker refers that in the production of these works *the artist and writer were often contracted independently* and *didn't meet, or met through the arranged connection of the project* [Drucker 2004, 4].

It is worth noting that Ambroise Vollard (1866-1939), another art dealer, published deluxe books that consisted in new editions of old texts (ex. Ovid, Shakespeare, Dante and Aesop) from the mid-1890s [Drucker 2004, 3; Bury 2007, 26; Silveira 2008, 36]. Example of this was Paul Verlaine's *Parallèlement* (1900) with lithographs by Pierre Bonnard [*see* ***Appendix A2.2***] [Vale Pereira 2008, 18; Kelly *et al.* 2010, 13]. *Parallèlement* marks the birth of the artists' books [Blundell and Blanckaert 2001, 155]. Although Vollard and Kahnweiler were contemporaries, it is worth noticing that the former dealt with new editions of old texts whereas the latter's were first editions of illustrated texts of writers that had never been published before [Bury 2007, 26].

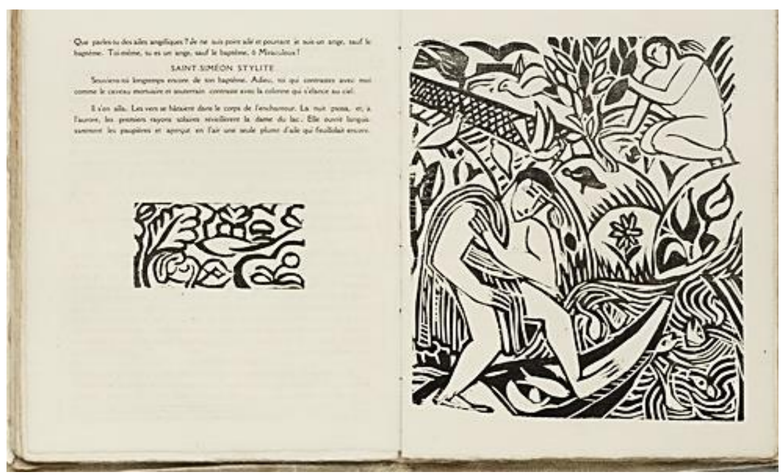

Figure 2.3. André Derain, Tailpiece (folio 25v) from *L'Enchanteur pourrissant* (1909) (woodcuts).
Source: MoMA collection website: www.moma.org.

As stated by the researcher Maria Jorge Vale Pereira, the Parisian artistic milieu was dominated by painting and sculpture in the early 20th century. The production of *livres d'artiste* became an opportunity of self-assertion in the cultural and artistic milieu as well as a mean to experiment new technical solutions, especially in the print field which allowed to give more visibility to the drawing[120] [Vale Pereira 2008, 18]. This fact may have interest Amadeo, since drawing was developing a

[118]The magazines (and almanacs, as the case of Wassily Kandisky's and Franz Marc's *Der Blaue Reiter Almanac* (1912)) made the reproduction of works of art accessible to an international audience [Bury 2007, 14]. Another example of this fact was the Manifesto of Futurism.

[119]Translation: The meeting between painter and poet.

[120]Amadeo de Souza-Cardoso was, without doubt, conscious of this fact. Actually, it was in the period of his career most dedicated to drawing that he published his album *XX Dessins*, in August 1912. A clear the strategy of Amadeo's international self-assertion with the

special role in his artistic evolution in that period of his career (as discussed in ***Chapter 1, section 1.2.1***), culminating with the production of *La Légende de Saint Julien l'Hospitalier*.

Souza-Cardoso met some of the artists and poets of the *École de Paris* that were working for Kahnweiler: André Derain and Guillaume Apollinaire that in 1909 collaborated in the conception of *L'Enchanteur Pourrissant*[121] (***Figure 2.3***) and Pablo Picasso and Max Jacob who carried out the *livre d'artiste Saint Matorel* in 1911 (the first of a trilogy)[122] [*see* ***Appendix A2.2***] [Bury 2007, 26].

Both Vollard and Kahnweiler produced deluxe editions for an elite market (collectors and bibliophiles) [Drucker 2004, 3; Bury 2007, 8]. These works were conceived on finest papers with original engravings (stencil or lithographs), fine binding and rare materials. They were produced in limited editions, finely printed (20-50 copies), unbound, cased or boxed [Adamowicz 2009]. There is an economic difference between common books and these books. The latter were significantly more expensive and their customers used to be contacted personally by the art dealer [Kostelanetz 1985, 30]. In ***Appendix A2.2***, a data-set of the Parisian artist's books published until 1912 is presented.

In what regards the production Russian *avant-garde* books, it is not known if Amadeo had knowledge of such books when he created *La Légende*. He might have had knowledge of them through the contact with artists from the *Académie Russe* (ex. Archipenko, Zadkine[123]) or the Delaunay couple. The Russian books were created in the context of the Russian Futurism [Drucker 2004, 46; Bury 2007, 28; Gurianova 2012, 59]. Their production began around 1912 [Compton 1978, 11; Vale Pereira 2008, 19]. When compared with the Parisian artist's books, the Russian books are located *at the other end of the spectrum*[124] as noted by the art historian and librarian Stephen Bury. According to this author the Russian books had as objective to react against the fine printing and elaborated cover of the Russian *Art Nouveau* and Symbolist publications and those published by Vollard and Kahnweiler [Johnson and Stein 2001, 21; Bury 2007, 28].

The Russian books promoted a new vision of the book as an instrument of formal experiment and artistic innovation [Drucker 2004, 49]. These books were deliberately cheaply produced with rough materials such as wallpapers, newsprint, cloth or collages. They also intended to be low-priced for an easier circulation as pamphlets in limited copies (around 300 copies) among artists, writers and students of new artistic concepts [Bury 2007, 29; Vale Pereira 2008, 19]. The main part of these handmade books was

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publication of these drawings is notorious, as the drawings were carefully distributed among various art critics and made known in the French and Portuguese press [Alfaro 2007, 155; Silva 2016, 21]. Definitely, for the Portuguese artist, the publication of the *XX Dessins* (author's edition) worked almost as a *livre d'artiste* although it is not [*see Appendix A2.2*].

[121]Some drawings of Amadeo's album *XX Dessins* brings to mind Derain's illustrations of *L'Enchanteur Pourissant*. This was the first *livre d'artiste* published by Kahnweiler [Strachan 1969, 38; Johnson and Stein 2001, 20]. It has been argued that this book marks the true origin of the modern artist's book [Johnson and Stein 2001, 63]. Note that Vollard and Kahnweiler were the main publishers of artists' books at the time.

[122]Other pioneers of *livre d'artiste* published until 1912 in Paris were: *Le Bestiare ou Cortège d'Orphée* (Raoul Dufy/Guillaume Apollinaire (1911)) and *Les Oeuvres burlesques et mystiques de Frère Matorel mort au couvent* (André Derain/Max Jacob (1912)) [Mitchell 1976, 11; Johnson and Stein 2001, 21].

[123]Cf. Alfaro 2007, 89.

[124]In the middle of the *spectrum* referred by Stephen Bury is located *La Prose du Transsibérien et de la Petite Jehanne de France* from January 1913 (printed in Paris in different colours), result of the collaboration between Blaise Cendrars and Amadeo's friend Sonia Delaunay [Drucker 2004, 50; Bury 2007, 32].

produced by artists themselves using graphic processes such as lithography, linoleum cutting, potato print, stencil cut and hectography[125] [Johnson and Stein 2001, 21; Drucker 2004, 49; Vale Pereira 2008, 19]. The unity of text and image was similar to that found in medieval manuscripts [Hellyer 2007, 140]. The major part of these books are also characterised by their small format.

Johanna Drucker made the follow list of some of these Russian *avant-garde* books, citing Susan Compton, an expert in such books. In what concerns the year 1912 (the same of Amadeo's *La Légende*), there were *Mirskontsa* [Worldbackswards][126] and *Igda v adu* [A Game in Hell] [Drucker 2004, 47; Gurianova 2012, 87]. Natalia Goncharova (1881-1962) and his husband Mikhail Larionov (1881-1964) participated in these two books with drawings, giving reputation to the work [Drucker 2004, 48; Bury 2007, 30]. The poems were provided by writers until then unknown [Vale Pereira 2008, 19]. According to Compton, *the handwriting was intended to convey the personality of the poet in the same way (…) drawing reveals the identity of the artist* [Compton 1978, 67]. Nevertheless, in the production of these books, artists and writers were at the same hierarchic level as the Parisian productions [Vale Pereira 2008, 19]. Goncharova and Larionov applied new aesthetics in these works: the first, the so called "Neo-primitivism"; the second created Rayonnism, with resemblances from Cubist and Futurist fragmentation of forms [Drucker 2004, 48].

Figure 2.4. Natalia Goncharova, *Game in Hell: A Poem* (*Igra v adu: Poema*) (p.13) (1912). Source:
The J.Paul Getty Museum website: http://www.getty.edu/

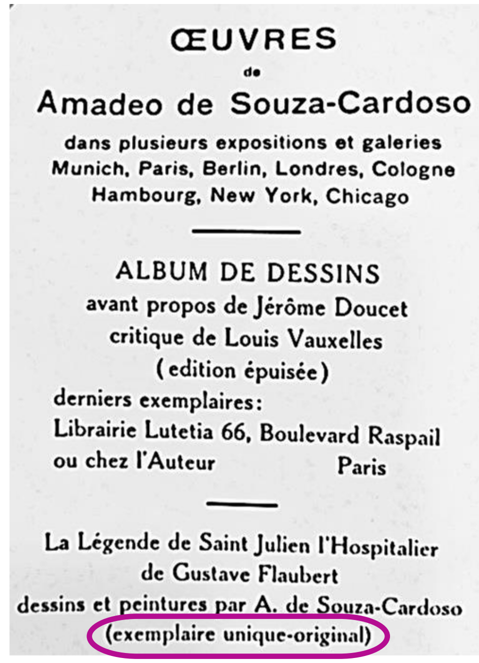
As already referred, it is possible that through the contact with artists from the Russian Empire, Amadeo had had access to the first Russian *avant-garde* books. In particular, Goncharova's drawings for *A Game in Hell* and Amadeo's *La Légende*, despite the aesthetic difference present similarities in the drawing (***Figure 2.4***). This fact seems to be related with the referred "neo-primitive" language, which resulted from the fusion between Cubism and Futurism values with the Russian folk art (Byzantine religious iconography, medieval illuminated manuscripts, non-European "primitive" art and *lubki*[127], rejecting "civilized forms of art") [Hellyer 2007, 140; Vale Pereira 2008, 19; Gurianova 2012, 133]. However, *A Game in Hell* was published for the first time in the middle of October 1912 [Compton 1978, 28; Kovtun 1987; Bury 2007, 30]. By its turn, Souza-Cardoso started the production of *La Légende* some months before, during the summer of 1912. Interestingly, other Russian book productions, from 1914 [*see* ***Appendix A2.3***], also have more similarity with Amadeo's illustration[128].

[125]This is an old process of replication of text or images, from a plate of gelatine treated with glycerine, were the data to reproduce were grooved [Vale Pereira 2008, 19].
[126]From December 1912 [Compton 1978, 90].
[127]*Lubok* (in the singular) was an art form produced between the 17th and the early 20th centuries that combined the Russian traditional iconography with engravings from the Western Europe [Vale Pereira 2008, 19]. It was a kind of folk lithographs [Bury 2007, 30].
[128]As referred by Helena de Freitas in the catalogue *Diálogo de Vanguardas*, it is quite probable that Amadeo and Natalia Goncharova did not meet each other during their stay in Paris and did not exchange visual information [Freitas 2006, 61]. Nevertheless, it is

This resemblance will be further discussed in ***section 2.3***. In ***Appendix A2.3***, a data-set of the Russian *avant-garde* books published until 1912 is presented.

In the luxurious version of Gustave Flaubert's *La Légende de Saint Julien L'Hospitalier*, Amadeo de Souza--Cardoso applied new graphic solutions to the dialogue established between text and image resulting in a pioneer work among the artists' books of the early 20th century. Furthermore, contrary to other artists, Souza-Cardoso opted to illustrate not the text of a contemporary writer, but one by Flaubert who lived in the 19th century [Ramos 2013]. As previously referred, the idea of selecting an old text was the practice of the artists' books published by Ambroise Vollard.

While its contemporaries of Parisian and Russian artists' books had many copies, *La Légende de Saint Julien L'Hospitalier* is a single piece and a unique copy. As observed by Maria Filomena Molder, see the last page of the album *12 Reproductions* (***Figure 2.5***) where *exemplarie unique original* can be read [Molder 2006, 10; Molder 2006b, 10].


ŒUVRES
de
Amadeo de Souza-Cardoso
dans plusieurs expositions et galeries
Munich, Paris, Berlin, Londres, Cologne
Hambourg, New York, Chicago

ALBUM DE DESSINS
avant propos de Jérôme Doucet
critique de Louis Vauxelles
(edition épuisée)
derniers exemplaires:
Librairie Lutetia 66, Boulevard Raspail
ou chez l'Auteur Paris

La Légende de Saint Julien l'Hospitalier
de Gustave Flaubert
dessins et peintures par A. de Souza-Cardoso
(exemplaire unique-original)

Figure 2.5. Last page of the album *12 Reproductions* (1916), BA-FCG.

In the manuscript itself, in one of the first fly-leaves *Ex unique préparé pour une edition qui n'a pas été publié*[129] is written in pencil [*see* ***Appendix A2.4***]. This detail seems to reveal a subliminal intention of publishing this work that never happened[130]. Despite Flaubert's opposition attitude to all forms of illustration of his own works[131] (as already mentioned in ***section 2.1.2***), Amadeo's version of *La Légende de Saint Julien L'Hospitalier* was not the first of the French novelist's works to be illustrated. Odilon Redon (1840-1916) illustrated the text by Flaubert – *Le Tentation de Saint Antoine* [Temptations of Saint Anton] (lithographs) in 1889 and 1896 [*see* ***Appendix A2.4***]. In 1895, Luc-Olivier Merson (1846-1920) undertook the illustration of *La Légende* (***Figure 2.6***) [Molder 2006b, 32]. However, according to the definition previously presented, these two books are not considered artists' books, but illustrated books or even bibliophile books[132].

interest to find some graphical similarities between Goncharova's work presented in that exhibition (dated, however, from 1918-1919) and Amadeo's in *La Légende* [*See Appendix A2.3*]. This fact will be discussed in s*ection 2.3*, as well.

[129]Translation: Single piece prepared for an edition that has not been published. Cf. Briend 2016, 50.

[130]However, according to the Portuguese newspaper *Jornal de Notícias* (February 5, 1958) in the occasion of the exhibition of *La Légende* in Paris, it had been sold and *Mrs. Lucie de Souza-Cardoso has made efforts to recover this work, which only succeeded in 1949.*

[131]The author and art historian Theodore Reff referred that Flaubert was convinced not only of the low level of commercial illustration, but of the harmful effect any visual image would have on his own imagery by making it explicit and thus limiting its power to evoke or suggest [Reff 1974, 126].

[132]A bibliophile book refers to a collection book in fine or unusual printing or special binding [*see Appendix A2.5*].

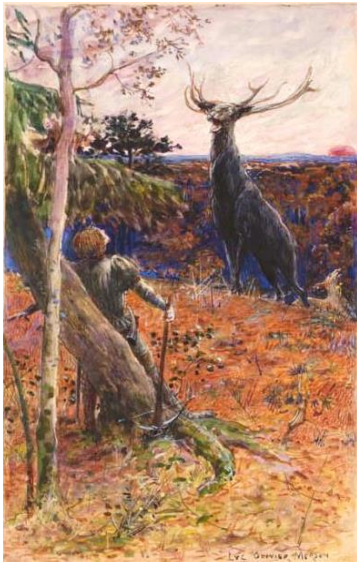


Figure 2.6. An illustration by Merson present in the exemplary of the book offered to the businessman Calouste Gulbenkian (1869-1955), MG-FC.

Merson was a famous painter and illustrator in Paris. Besides having designed postage stamps, he was also the author of the first French banknotes and collaborated in the conception of the mosaics of the chancel vault of the Basilica *Sacré-Coeur* in the French capital [Norman 1977, 146; Jonas 2000, 226]. It is most certain that Amadeo knew Merson whose illustration of *La Légende* (***Figure 2.7***) he eventually got to know from his usual strolls at the Parisian bookshops[133]. This version consists in small engraved vignettes around the text. In the writer, Marcel Schwob's words, *they frame Flaubert's tale with exquisite decor of the 15th century. They have all the mystical grace that a great writer would have wished* [Schwob 1895]. Nevertheless, Amadeo's work on Flaubert's tale goes more than the mere act of copying and illustrating it, as it will be further discussed.

Figure 2.7. Engrave by Merson from *La Légende*, representing Julian in Jesus Christ's arms (p. 72) Source: BNF website: gallica.bnf.fr

Henri Matisse has written *I make no difference between the construction of a book and that of a painting*[134]. The same can be said in what regards the conception of Amadeo's book. Comparing with the *livres d'artiste* of that time, *La Légende de Saint Julien L'Hospitalier* was almost total and absolute creation from an artist and not a product resulting from the initiative of an editor or art dealer as Kahnweiler. Amadeo's manuscript does not only represent a relaxing piece of reading but also communicates something to the reader through the way how its volume is structured, in the form of a codex. Effectively, the handwritten version of *La Légende* was created as an art object and designed as a unit. So it can be classified as artist book (a *livre d'artiste* in the Parisian context). The following words by the curator Deborah Wye can also be applied to Amadeo's *La Légende* case:

> *Holding such a book in one's hand, perusing its pages, scrutinizing its images and text, the viewer relates to this distinctive art form in an altogether personal way. Unlike a painting, which makes an initial immediate impact, a book reveals itself only in a time-related sequence. To construct such an experience, the artist may assume the dual role of author and create text along with them (…). Whatever shape a book takes, it is clear that this creative medium has a unique set of characteristics that influences one's perception and experience of it as a work of art* [Rowell and Wye 2002, 10].

[133] Helena de Freitas mentioned that Amadeo was a compulsive and attentive reader [Freitas 2008, 425]. The artist's personal library that integrates his estate at BA-FCG witnesses very well this fact. Moreover, Merson was also one of the notable teachers of *Académie Vitti* [Berès 2006, 83]. It is not known if Amadeo met him while studying there.

[134] Henri Matisse apud Elderfield 1992, 56.

Chapter 3 will go into detail on the paper and binding of Amadeo's work. It was previously produced in single sheets of paper of high quality, like the deluxe Parisian *livres d'artiste*, having been bounded later. However, the intention of working in book form was underlying. Although Amadeo respected the distinction between text and image he did not follow the construction of facing pages as did the *livres d'artiste* of his time[135]. He opted to have blank pages on the left and sometimes also on the right. As mentioned in ***section 2.1.2***, Amadeo de Souza-Cardoso deliberately organised Gustave Flaubert's text in his own way, sometimes starting a page of his manuscript not in the beginning of a paragraph but several times in the middle of it. This freedom that transfigures the text is characteristic of the *livres d'artiste*. The text became more a text to look at, than a text to be read[136]. As referred by Drucker, all books are visual, with presence and character. They are tactile and spatial as well [Drucker 2004, 197]. *La Légende de Saint Julien l'Hospitalier* is not an exception. Turning over the pages of Amadeo's *livre d'artiste*, in specific parts, the presence of several blank pages (***Figure 2.8***) that are numbered as the other pages of the manuscript is observable. In the context of the painter's illustration, it can be assumed as breaths (or *fermate* like in musical sheets or even as the walls of a museum) in the reading of Gustave Flaubert's text. Thus, the reader becomes an active participant in the experience offered by the book. The same is also observed in the initial pages of the manuscript and in the synopsis. These blank pages are like "antechambers" of specific moments of the tale that Amadeo wished to highlight. The blank pages that proceed the key moments (*see* ***Table 2.1***.) of the illustration are observable in ***Appendix A1.1***.

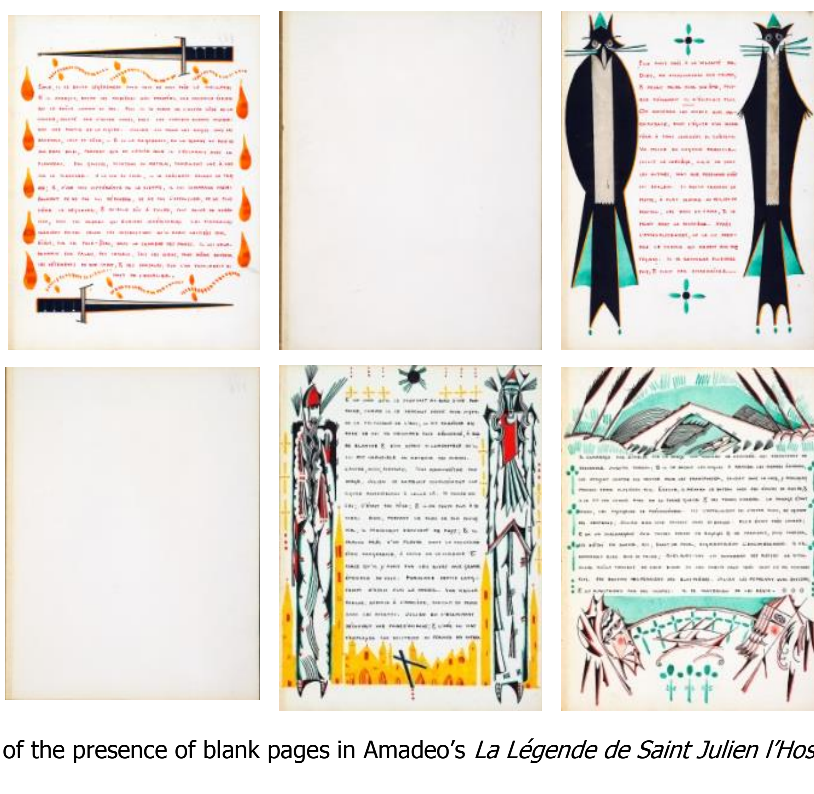


Figure 2.8. Examples of the presence of blank pages in Amadeo's *La Légende de Saint Julien l'Hospitalier*, MG-MC.

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[135]Cf. Drucker 2004, 4.
[136]Cf. Melot 1984, 207.

Table 2.1. Location of the blank pages in *La Légende de Saint Julien l'Hospitalier*.

Blank page located before	***Key moment***
p. 51	Beginning of the tale
p. 55	Presentation of Julien's father and mother
p. 59	Prophecy by the gypsy to Julien's father
p. 62	The little child starts his education with a monk
p. 65	The young Julien showed enthusiasm with the narrations of his father's friends
p. 69	Julien showed his violent impulses
p. 73	Description of Julien's falconry
p. 76	Allusion to Julien's bravery
p. 80	*Idem*
p. 84	Meeting between Julien and the deer
p. 87	Julien tormented by the prophesy of the deer
p. 91	(Beginning of chapter II)
p. 93	Julien ran away home and joined a group of adventurers
p. 96	Julien, fighter in several battles
p. 99	The Emperor of Occitania offers Julian, his daughter's hand as a sign of gratitude
p. 103	Julien refused any invitation of going hunting
p. 107	The father and mother of Julien arrived in his castle searching for their son
p. 111	Julien's impotence against the animals of the forest
p. 115	Julien found two bodies sleeping in his bed
p. 119	Narration of Julien's parents burial
p. 121	(Beginning of chapter III)
p. 123	Julien decided to became a beggar
p. 127	Julien saw in his own reflection in the water, the image of his father and wanted to kill himself
p. 131	Julien heard the voice of the Leper
p. 134	Julien's final metamorphosis
p. 139	(Terminus of the illustration with the illustration of the year 1912)

The use of blank pages by Amadeo in *La Légende* as a visual resource, brings to mind an analogous situation that can be found in the editions of the book *The Life and Opinions of Tristram Shandy, Gentleman* (1759-1767) by the Irish writer Laurence Stern (1713-1768), who presents the famous "black pages", unusual in the panorama of typographic works of that time (***Figure 2.9***). In the context of the book, it symbolises the death and a sort of homage to one of the main characters of the story (Yorick). This resource was praised by Stern's contemporaries and aimed to create emotions in the reader and an empathic connection with this character. In the manuscript *La Légende de Saint Julien l'Hospitalier*, the white pages also contribute to a similar effect, promoting a different sort of reading experience of Flaubert's tale. However, in Stern's case, the black pages are part of the narrative while in Amadeo's case, the white pages are not. They are an aesthetic resource used by the artist.

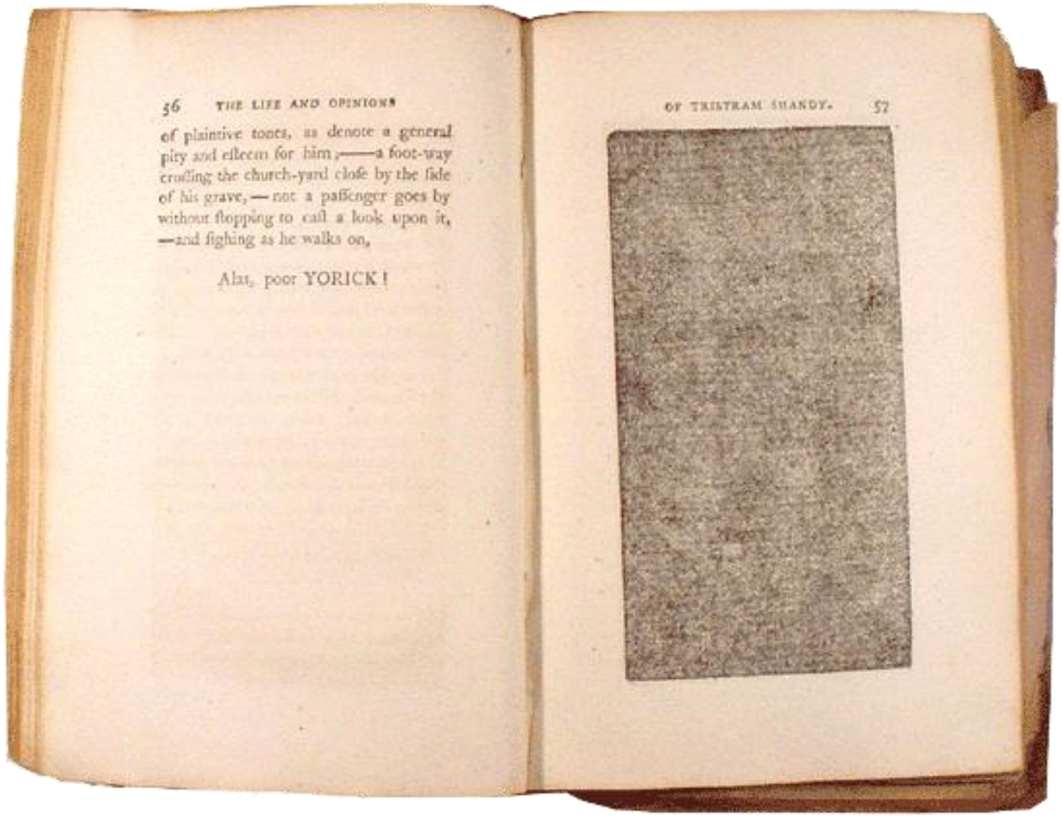

Figure 2.9. Reproduced from Laurence Sterne, *The Life and Opinions of Tristram Shandy, Gentleman* (1759-67), in *The Works of Laurence Sterne. In Ten Volumes Complete*. (London, 1793) (p. 56-57). (Source: http://instruct.uwo.ca/english/234e/site/supplmts/blckpg.html. Last accessed on February 11, 2017).

Paulo Pires do Vale presents an interesting metaphor: *we open the book and turn the pages as slowly opening a door and passing through a house and accompanied by someone (the artist himself)* [Pires do Vale 2012, 101]. These poetical spaces can be observed in *La Légende*. In Amadeo's work, each white page can be seen as doors of the referred house, whose many divisions (the illustrated pages of the manuscript) will be explored in detail in ***section 2.3***. On visiting these divisions, the reader is surprised by the aesthetic experiences made by Souza-Cardoso (a dialogue between modern and medieval influences). At the end of the illustration, this *livre d'artiste* invites the reader to cross four doors (four blank pages) [*see* ***Appendix A1.1***], that will carry him/her back to the reality, but transformed by the immense power that a book has to change the lives of those who interact with it[137]. As usual in Amadeo de Souza-Cardoso's oeuvre, *La Légende de Saint Julien l'Hospitalier* is undoubtedly an emotive product[138]. A book is more than a book when it becomes a work of art[139].

---

[137]Cf. Pires do Vale 2012, 104.
[138]Cf. letter by Amadeo to his uncle Francisco in 1910: *It is not possible to make a work of art without a thrill* [apud Alfaro 2007, 122].
[139]Cf. Stein 2001, 17.

The pages of *La Légende* also present some resemblances with the so-called precursors of the conceptual practice of artists' books. Amadeo's manuscript finds meeting points with his illuminated prints by the British engraver William Blake (1757-1827) (***Figure 2.10***). This fact is expressed not only in the relationship established between text and image but also in certain mysticism, a nocturnal side and in the revisitation of the past. According to Johanna Drucker, the book was seen by for William Blake, as a mean *of expressing his cosmological beliefs*. Drucker referred that Blake's printed pages were illuminated by means of water-based paints that were grounded by Blake himself, *to keep colours vivid and simple* [Drucker 2004, 23]. In Amadeo de Souza-Cardoso's case, as referred in ***section 2.1.2***, *La Légende* meant to the artist to be an instrument of graphical self-assertion. The Portuguese artist also opted to use the watercolours technique[140] and bright colours. However, there has been no data that allow stating that the Portuguese artist's practice was inspired by that of William Blake.

La Légende de Saint Julien l'Hospitalier also finds similarities with the works of another precursor of artists' books, the British William Morris (1834-1896), co-founder of the movement *Arts and Crafts*. Morris collaborated in the development of modern 20th century printing. His first printed work was published in 1896. It was entitled *The Works of Geoffrey Chaucer Now Newly Imprinted*. This, and in general all Morris's works are characterised by the medievalist attributes like ornamental borders and initial letters [Mitchell 1976, 10]. In fact he collected medieval manuscripts [Drucker 2004, 28]. The bookbinding of the referred work presents resemblances with *La Légende*, being comparable to a medieval codex (***Figure 2.11***). Morris's works were known in the *avant-garde* artistic milieu [Strachan 1969, 26]. Amadeo might have got knowledge of him in this way. However, no data has been found that can establish a connection between Amadeo and Morris's printed book. Both Amadeo and Morris shared in common interest in medieval manuscripts. Souza-Cardoso's interest in such manuscripts will be discussed in ***section 2.3***.

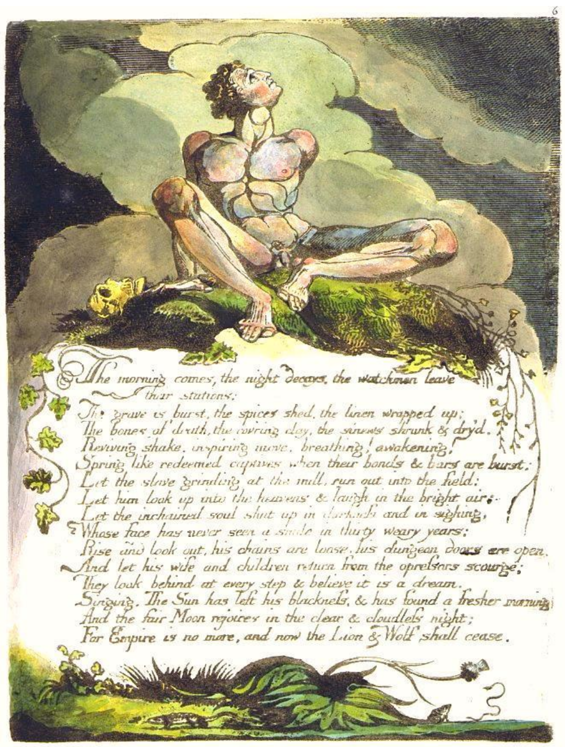

Figure 2.10. William Blake, *America: A Prophecy* (1793) Source: The William Blake Archive website http://www.blakearchive.org/

[140]An example of illustration in watercolours is Guy de Maupassant's *Le Maison Tellier* with illustrations by Henriot (Henri Maigrot) [*see Appendix A2.5*]. *La Légende* finds some meeting points with this example.

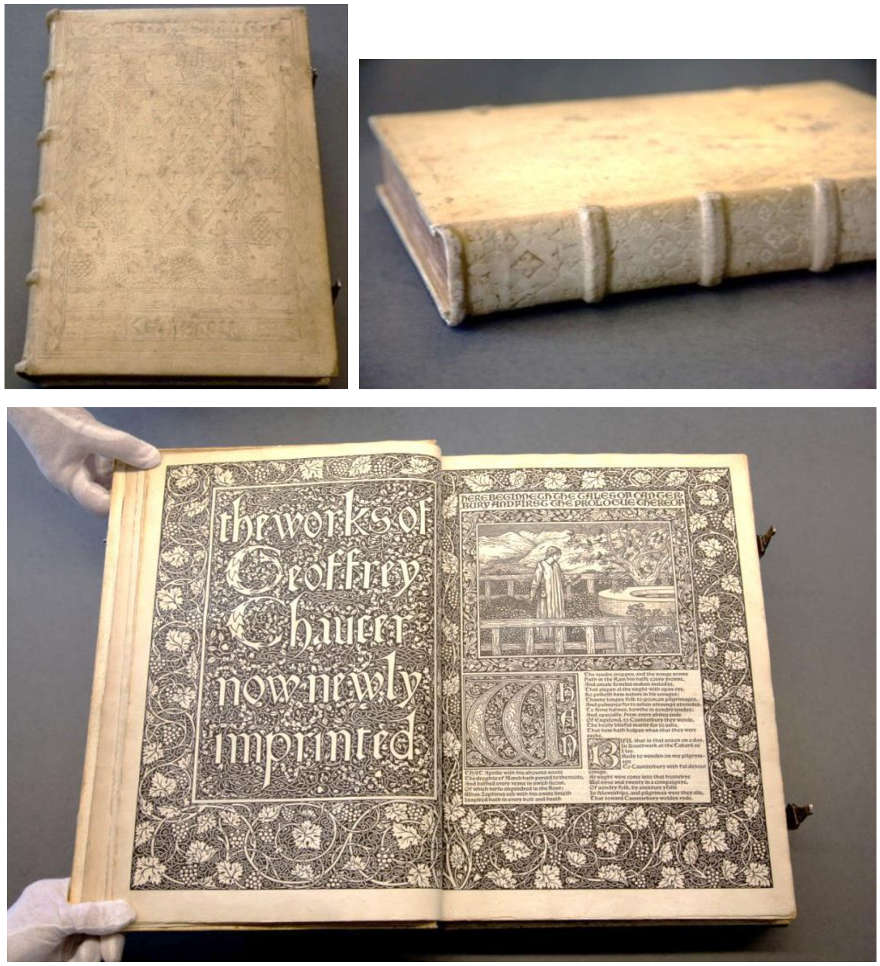

Figure 2.11. William Morris, *The Works of Geoffrey Chaucer Now Newly Imprinted* (1896-1898).
Bound in white pig skin. (Source: Queen's University Kingston (Ontario, Canada) website:
http://library.queensu.ca/blog/virtual-exhibits/case-two-the-kelmscott-chaucer/ Last accessed on October 1, 2016).

As already referred, in *La Légende*, it is clear that Amadeo conceived his *livre d'artiste* with the intention of a work with a specific structure and form.

A book is characterised by its binding too. Elza Adamowicz states *bindings in single or limited editions enhance the book as a material object, appealing not only to the eyes but also to the sense of touch* [Adamowicz 2009]. The researchers John Anzalone and Ruth Copans pointed out that the bookbinding in an artist's book can provide interpretative strategies for approaching the text [Anzalone and Copans 1991].

La Légende de Saint Julien l'Hospitalier is an innovative artist's book but its binding is refined as the Parisian deluxe *livres d'artiste* productions of that time (***Figure 2.12***). The use of parchment and the presence of the remains of three coats of arms, introduces the reader to the medieval ambience of Flaubert's *La Légende de Saint Julien l'Hospitalier*. The identification of this material will be better discussed in ***Chapter 4***.

The two elements – pages (text block) and bookbinder – were carefully prepared by Amadeo. Together, they are able to communicate something to the reader. As referred by Anne Moeglin-Delcroix in an artist's book, *the book is itself an art piece and not a medium of its diffusion* [Moeglin-Delcroix 1997, 51]. Anzalone and Copans also observed that in artist's book *the heft and volume of the book, its format, the smell of the paper, and the textures of the cover – all these sensual, tactile pleasures rarely leave the reader indifferent* [Anzalone and Copans 1991]. In fact, the involvement of senses can be felt when reading Amadeo's *La Légende*. Moreover, as mentioned by Johanna Drucker, in the conception of an artist's book, the artist is self-conscious about book form, rather than merely creating a highly artistic book [Drucker 2004, 21]. This author also pointed out that, *it is rare to find a 'livre d'artiste' which interrogates the conceptual or material form of the book as part of its intention* [Drucker 2004, 3]. It was observed that Amadeo's *La Légende* is among these exceptions. All the elements that make up this artist's book establish a dialogue with the reader who handles it.

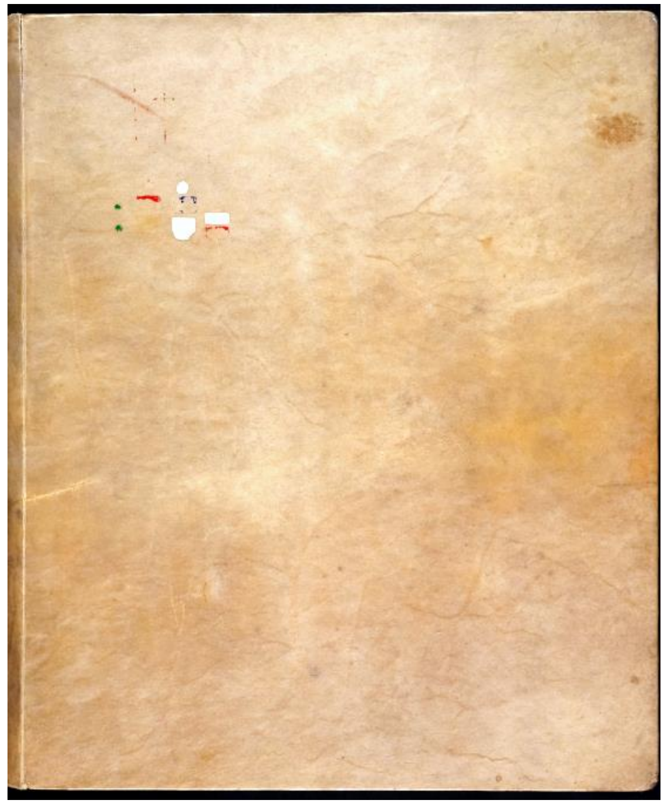

Figure 2.12. Cover of Amadeo's manuscript *La Légende de Saint Julien l'Hospitalier* (1912), MG-MC.

In comparison to its contemporaries, Souza-Cardoso's handwritten *livre d'artiste* is a singular and uncommon piece, reflecting the individual *modernity* of this artist and his geniality. Other examples of handwritten manuscripts were created around mid-20th century (***Figure 2.13***) [*see* ***Appendix A2.6***]. However, all of them present limited number copies while *La Légende de Saint Julien l'Hospitalier* always remained a single copy.

Figure 2.13. Example of a handwritten artist's book (subsequently printed). Henri Matisse, *Jazz* (1943--1944) [Johnson and Stein 2001, 12].

2.2.3 *La Légende* in the context of the Portuguese artist's books of the early 20th century

In what concerns the practice of artists' books in Portugal, there is an absence of critical studies. This fact is justified by Catarina Figueiredo Cardoso, who related it with historical factors that occurred in Portugal in the early 20th century, namely, the turbulent events associated with the Republican revolution in 1910 and the *repressive and isolationist* dictatorship regime between 1926 and 1974. As mentioned by this author, the latter blocked any kind of non-traditional publications. Thus, the production of artists' books was not accounted for, for a long period, until the 1980s[141] [Cardoso 2012]. In the referred study, Cardoso places Amadeo's *La Légende* among the earliest artist's books.

José-Augusto França pointed out the names of the most important artists from the first generation of Portuguese modernist artists: Amadeo de Souza-Cardoso, Eduardo Viana and Almada Negreiros [França 2011, 171]. However, as referred by Helena de Freitas, Amadeo was the only one that truly established a dialogue with the artistic *avant-garde* of that time[142].

Aiming at placing *La Légende de Saint Julien l'Hospitalier* in the context of the Portuguese artist's books, a brief overview of the production of these same books until 1912 is discussed below.

It is important to refer that the first historical event associated to modern art occurred in Portugal in March 1911 (the previous year of Amadeo's *La Légende*). It was the *1ª Exposição Livre*[143] at *Salão Bobone*, Lisbon [França 2004, 11]. Amadeo did not want to join in [França 2004, 24]. Eduardo Viana and a group of young artists that were studying in Paris[144] participated in it, showing about one hundred pieces (still lives, portraits, landscape paintings, caricatures, *pochades* and some studies), some of them related to Naturalism, but also to Impressionism and Symbolism [França 2004, 12; Pinto de Almeida 2008]. It was a shy awakening to modernism in Portugal in comparison with the *avant-garde* artistic revolution that was occurring in Paris at the same time.

The second modernist event occurred in May 1912 – *1º Salão dos Humoristas* at *Grémio Literário* in Lisbon [França 2004, 14]. Amadeo thought about participating but at the end he did not [França 2004, 13; Silva 2016, 27].

Eduardo Viana's paintings still reflecting a naturalistic and "cezannian" taste and he was painting still lives and landscapes [Pinharanda 2009, 43; Fortes 2010, 69]. However, around 1915 his artistic projects observed great evolution through contact with artists like Amadeo and the Delaunay couple.

[141]The book art collector Catarina Figueiredo Cardoso and the artist Isabel Baraona are the editors of a database of Portuguese artists' books and author's graphic edition (www.tipo.pt). Presently, this archive presents only contemporary artists' books.
[142]Cf. Documentary *Amadeo de Souza-Cardoso – À velocidade da Inquietação* (©Panavídeo Produções, Portugal), 2013.
[143]In this controversial exhibition, the artists who participated in it were treated as madmen. Manuel Bentes (Amadeo's friend), who led the event uttered the following word that became famous: *Art has no systems but emotions (…) We want to be free! We fled from teaching dogmas, from the master's impositions, and when possible, from the influences of schools, because we believe that artists have a single school – Nature; a single dogma – Love* [apud França 2004, 12] (Translation by the author of this dissertation).
[144]Manuel Bentes, Francisco Smith, Emmerico Nunes, Domingos Rebelo, Francisco Álvares Cabral and Alberto Cardoso [França 2004, 12; Pinto de Almeida 2008]. José-Augusto França referred that almost all of them (with exception of Vianna and Emmerico) had modest careers [França 2004, 12]. Emmerico Nunes had future success as humoristic drafter [*Ibidem*, 13].

This was a very fertile period for this artist [França 2004, 20]. Among the collection of his works, no artist's book was found.

Figure 2.14. Almada Negreiros,
O Pierrot que Nunca Ninguém Soube que Houve. História Trágica e Ilustrada com Sol e Palmeiras (1921-1922) [Ferreira and Santos 2014, 73].

José de Almada Negreiros[145] lived in Paris between 1919 and 1920 [França 2004, 106; Ferreira 2008]. He met some of the artists from that artistic universe[146]. Eventually, it was there that he had contact with the production of the Parisian artists' books that he started producing a few years later. Those productions were shown in the exhibition *Almada Negreiros: O que nunca ninguém soube que houve* [What nobody ever knew that there was][147]. His earliest artists' books date from around 1920: they were a set of books entitled *Parva* (1920) and *O Pierrot que Nunca Ninguém Soube que Houve. História Trágica e Ilustrada com Sol e Palmeiras*[148] (1921-1922) (***Figure 2.14***). This handwritten book was created with text and illustrations by Almada himself, almost ten years after Amadeo's *La Légende de Saint Julien l'Hospitalier* and also after Almada's return from Paris.

Definitely, in 1912, the concept of artist's book was unknown in a country closed to new aesthetic ideas. From this brief analysis, it seems possible to point out Amadeo de Souza-Cardoso's 1912 *La Légende de Saint Julien l'Hospitalier* as the pioneer artist's book created by a Portuguese modernist artist, engaged with the *avant-garde* movements from his time.

[145] *Poet-novelist-storyteller-playwright-essayist-conferencist-draughtsman-painter-stained-glass-artist-engraver.illustrator-caricaturist-humorist-dancer-scenographer-costume-designer-choreographer-and-everything else* [Santos 2014, 135].
[146] Almada met Max Jacob, Picasso, Brancusi and other modernist artists [Ferreira 2008].
[147] This exhibition was carried out between December 2014 and March 2015 at *Museu da Electricidade – Fundação EDP* in Lisbon. It was curated by Sara Afonso Ferreira. The exhibition marked the centenary of the magazine *Orpheu*.
[148] Translation: *The Pierrot Nobody Ever Knew There Was. A Tragic Story Illustrated with Sun and Palm Trees*.

2.3. Wings of the falcon: Modernism and Medievalism

In the essay for the deluxe edition of the *facsimile* of *La Légende de Saint Julien l'Hospitalier*, Maria Filomena Molder quoted Gustave Flaubert in an interesting letter to his friend Hippolyte Taine in 1866: *But ever so often the artistic image is built slowly – step by step – like the diverse parts of a scenery in construction*[149]. Having such words in mind, this section is devoted to the analysis of this manuscript, patiently produced by Amadeo, aiming to identify the plurality of sources in which his modernism was inspired until the creation of this *livre d'artiste* and in the dialogue established with medieval illuminated manuscripts.

✤ Concarneau

Having read the *Letters of Flaubert*[150], Amadeo de Souza-Cardoso was certainly aware that it was in Concarneau that the French novelist started the written production of the tale in 1875. So, visiting the *Château de Keriolet* (Concarneau) during the summer of 1912, Amadeo found ideas for his illustration as will be seen[151]. In fact, it is not hard to imagine Julien's story in that scenery. In Flaubert's words concerning Julien's father's castle: *inside, everywhere metal glowed; in the bedrooms, tapestries protected against the cold; the wardrobes were bursting with cloths, the casks of wine were piled up in the cellars and the oak chests were at breaking point with the weight of the sacks of money. In the armoury, among banners and embalmed faces of wild animals, you could see weapons of all times and of all nations*[152].

Figure 2.15. *On the left:* From the artist's estate at BA-FCG, a detail of a photo taken by Amadeo of one of the tapestries present on the interior walls of the *Château de Keriolet* (photo by the author of this dissertation with the permission of FCG). *On the right*: p.36 of *La Légende*, MG-MC.

As previously referred, Maria Filomena Molder and Catarina Alfaro mentioned that the artist gave particular attention to the Flemish tapestries with medieval hunting scenes which in the time, were present in the interior walls of the *château* [Molder 2006b, 49, Alfaro 2007, 161]. Thus, from an attentive investigation of Amadeo's estate at BA-FCG, it was possible to find photos of one detail photographed by

[149]Cf. Molder 2006b, 28 (Translation by the author of this dissertation).
[150]This fact was already referred in *section 2.2*. Letter from Amadeo to his sister Helena [apud Molder 2006b, 26].
[151]In 1907, during his first trip in Brittany, Amadeo referred to his mother the emotion that those panoramas caused in him: *I can't write. Epistolary silent crisis. But it is not my fault; It is from my thrilled spirit for such delicate sensations (…)* [apud Alfaro 2007, 69] (Translation by the author of this dissertation).
[152]Cf. Flaubert 2005, 49 (Translation of the excerpt by the author of this dissertation).

the artist from one of those tapestries (***Figure 2.15***). Unexpectedly, one finds a formal relationship with the representation of Julien with his oriental wife.

Going through the several rooms of this castle, Amadeo was attracted to the chimney of the *Salles des Gardes* [*see* ***Appendix A2.7***] where a warrior is represented with several coats of arms around him (***Figure 2.16***). The illustration in p.53 of *La Légende* as well as the image of Julien as warrior in p. 39 seems to find formal similarities with that source. Besides, the representation of the coats of arms with a crown on the top is also represented by the Portuguese artist in other pages[153].

Figure 2.16. *On top:* Chimney of the *Salles des Gardes* of the *Château de Keriolet*. Courtesy: Monique Dupuy-Kiefer. *Bellow: La Légende de Saint Julien l'Hospitalier* (1912), p. 53 and 39, MG-MC.

[153]Cf. p.65, 67, 96, 97, 103, 105 and 108 of *La Légende* [*see Appendix A1.1*].

During these holidays, Souza-Cardoso sent his mother a postcard with a photo of the facade of the *Château de Keriolet* (***Figure 2.17***) expressing: *Beautiful castle isn't it?*[154]

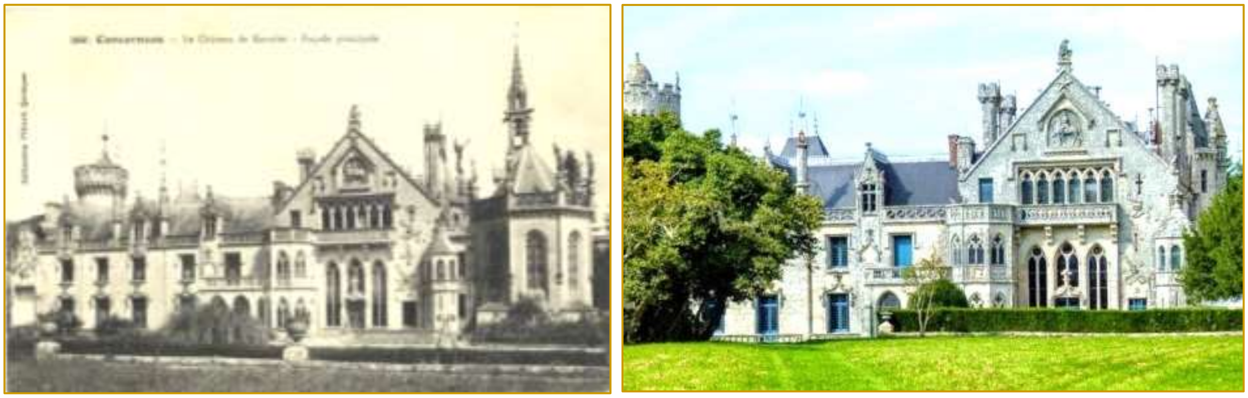

Figure 2.17. *Château de Keriolet*: *On the left*: Amadeo's postacard sent to his mother, BA-FCG. *On the right:* the castle nowadays. Courtesy Guy Le Page.

The impression that this building caused in the Portuguese artist is evident from the representation of other decorative elements present in the manuscript. As presented in ***Chapter 1***, the theme of the rider was dear to Amadeo[155]. An interesting aspect that may have caught the artist's attention was the bas-relief portraying king Louis XII riding a horse (***Figure 2.18***), presented in the facade of the castle. It is clear the influence of this architectonic element in the illustration of Julien's father [*see* p.18 in ***Appendix A1.1***], who *as soon as the weather was good would ride the narrow paths on a mule[156].* However, the inspiration for this drawing could also have come from the *fresco The Procession of the Magi* (***Figure 2.18***) by Benozzo Gozzoli (1420-1497), present in the book edited by *Gowans & Gray* related with this artist, that Amadeo acquired in the first years of his career[157].

Figure 2.18. *Top-left:* bas-relief portraying king Louis XII in the façade of the *Château de Keriolet*. Courtesy Guy Le Page. *On the right: La Légende de Saint Julien l'Hospitalier* (1912), p. 18, MG-MC. *Bellow-left:* Benozzo Gozzoli, *Procession of the Magi* (1459-60). Source: Palazzo Medici-Riccardi website: http://www.palazzo-medici.it/

[154]Cf. Alfaro 2007, 163.
[155]Amadeo continued representing hunters riding horses along his career [Cf. Freitas 2008b].
[156]Cf. Flaubert 2005, 50 (Translation of the excerpt by the author of this dissertation).
[157]Cf. Alfaro 2010, 27 and *The Masterpieces of Benozzo Gozzoli (1420-1497)*. Glasgow: Gowans & Gray, Ltd, 1911 (p.20-21).

Elongated gargoyles, that depicted dragons with faces downwards, spat out rain water to the cistern[158]*.* The gargoyles of the *château* seem to have inspired Souza-Cardoso also in the representation of some fantastic beasts (evil). Moreover, it is possible to observe again coats of arms and other elements such as *fleurs du lis*[159], stars and crowns have being present in the artist's work (***Figure 2.19***). Note that the elongated shape of the human being represented in *La Légende* shows likewise affinity with the neo--gothic architecture of the *Château de Keriolet*. As referred in a letter to his uncle Francisco, Amadeo admired the gothic style of the great medieval cathedrals[160].

Figure 2.19. *On the left (golden frame):* Some details from the exterior of the *Château de Keriolet*. Courtesy Guy Le Page (photos on top) and *Ysis photos* www.photographe-bzh.fr (photos below). *On the right:* Some details from *La Légende de Saint Julien l'Hospitalier* (1912), MG-MC.

An old boat with the stern buried, lifted the bow in the middle of the reeds. Julien, on examining her, discovered a pair of oars; this inspired him to put its life into the service of others[161]*.*

Concarneau is located in South-Finistère and bathed by the Atlantic Ocean. The city picturesque and fishing port attracted many artists especially in the 19th and 20th centuries that depicted the fishing boats (especially, sardines and tuna) in various paintings [*see* ***Appendix A2.8***]. Amadeo de Souza--Cardoso was not an exception. These boats, certainly, reminded him of his native country, particularly, Aveiro and Ovar which he admired so much[162]. The illustration of p. 63 (and also of p. 124 and 136) [*see* ***Appendix A1.1***] (***Figure 2.20***) with boats and sardines allude to this connection with the port of Concarneau. This fact is also evident on p.123 as will be further seen.

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[158]Cf. Flaubert 2005, 49 (Translation of the excerpt by the author of this dissertation).
[159]As well present, for instance, in the mosaics of the kitchen of this castle [*see Appendix A2.7*].
[160]In a letter from 1910 to his uncle Francisco, the Portuguese artist stated: *(…) the palaces of the Renaissance are haystacks when compared with [the Gothic] cathedrals* [apud Alfaro 2007, 122]; (Translation by the author of this dissertation). In p. 127 of *La Légende* [*see Appendix A1.1*], Amadeo seems to illustrate a Gothic cathedral.
[161]Cf. Flaubert 2005, 79 (Translation of the excerpt by the author of this dissertation).
[162]Cf. Letter by Amadeo to Lucie (Espinho, 1910) [apud Alfaro 2007, 132].

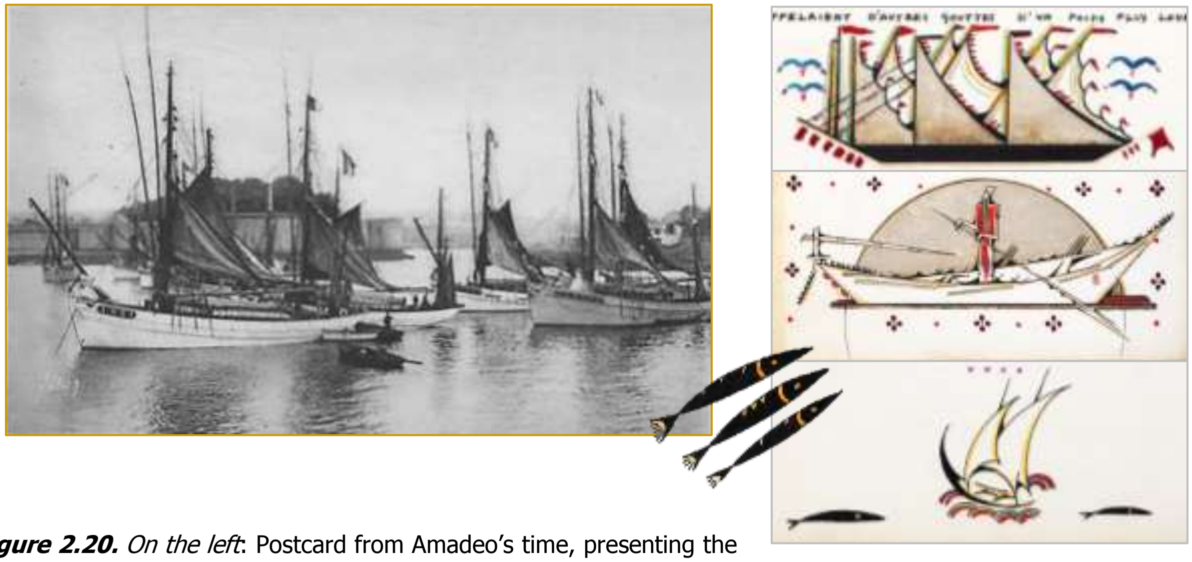

Figure 2.20. *On the left*: Postcard from Amadeo's time, presenting the fishing boats that use to stay in the port of Concarneau. *On the right:* Some details from *La Légende de Saint Julien l'Hospitalier* (1912), MG-MC.

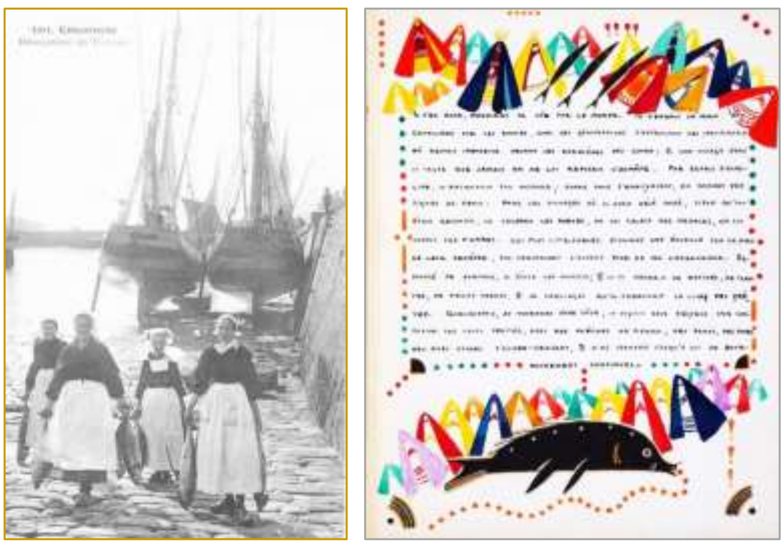

Figure 2.21. *On the left*: Postcard from Amadeo's time, presenting the *sardinières* of Concarneau. *On the right: La Légende de Saint Julien l'Hospitalier* (1912), p. 123, MG-MC.

The Portuguese painter's interest for ethnology is known[163]. In a letter to Lucie from 1910, he wrote about the beauty of the *varinas*[164] [the lady fishmongers] from Aveiro. However, from this trip in Brittany, the illustration of *La Légende* discloses the presence of the *sardinières* from Concarneau (***Figure 2.21***) who used to wait for the fish boats at the port [*see* ***Appendix A2.8***]. In addition, having been in that region in August, maybe Amadeo de Souza-Cardoso was present at the Festival *des Filets Bleus*[165] with the nomination of the "queen" of the event. However, no document was found that proves the presence of the artist on this occasion. In this context, the black animal in p.123 (***Figure 2.21***) seems to represent a fish and not a dolphin, as pointed out by Maria Filomena Molder [Molder 2006, 41].

[163]This fact finds bridges with Amadeo's contact with artists from the Russian Empire, inspired on the folk art and transmitted it to the Parisian artistic milieu (from "Neo-primitivism"). Example of that was Sonia Delaunay [Marcadé 2006, 365; França 2011, 179]. Her interest on Portuguese folk art and ethnology is clear in her works from 1915-17, carried out while living in Vila do Conde This fact also inspired Amadeo and Eduardo Viana in their works from that same period [França 2004, 49; Freitas 2008, 33; Alfaro 2010, 61].
[164]Cf. Letter by Amadeo to Lucie (Espinho, 1910) [apud Alfaro 2007, 132]. In a postcard to Walter Pach, from 1912, with a photo of these *varinas*, Amadeo wrote: *Here a beautiful woman from the Ocean* [apud Molder 2006b, 50].
[165]A traditional feast in Concarneau that uses to occur during the month of August (Cf. www.festivaldesfiletsbleus.fr).

Strangely, the representation of these ladies – some of them with a crown – is similar to that of the Virgin Mary painted in *Procession of Corpus Christi* (***Figure 2.22***). The association that Amadeo established between the profane and the sacred in the illustration of this page finds a bond with the reflection of Maria Filomena Molder who refers: *it is in this oscillation of identity that the impetuous of the mystic is incrusted*[166]. In fact, this page of *La Légende* concerns the moment in which Julien decided *to be a begger through the world*[167] and this is when his sanctification process begins.

Figure 2.22. *In front:* Detail from *La Légende* (p.123). *Behind:* Detail from *Procession of Corpus Christi.*

Figure 2.23. *On the left: La Légende de Saint Julien l'Hospitalier* (1912), p. 125, MG-MC. *On the top-right:* Portuguese monarchic flag (used until 1910). *Bellow-right:* Portrait of King D. Manuel II by Amadeo (c. 1907) [Cf. Freitas 2008b, 134].

This "oscillation of identity" can also be seen in the illustration of p.125. The image with the allusion to the chess table, the king in horizontal position and the decorative elements (crowns, royal flags and coat of arms) seem to exclaim: «Checkmate!». Actually this page narrates Julien's unbearable suffering that leads him to desire his death[168]. However, the king is depicted with his eyes opened, which means Julien did not die.

The monarchic convictions that Souza--Cardoso (and his family) nourished and the overthrow of the Portuguese monarchy with consequent raise of the republic in 1910[169] are definitely shaped on this page. The blue and white flags recall the Portuguese monarchic flag. The small coats of arms painted are similar to the five shields ( ) of the mentioned flag (***Figure 2.23***). The red cross depicted finds similarities with the crosses of medieval military orders ( ). In addition, Amadeo's representation of the king seems to allude the fall of the last Portuguese King – D. Manuel II.

[166]Cf. Molder 2006b, 22. As analysed by Molder, this aspect results from the influence of philosopher Henri Bergson's *L'Évolution Creatrice* [Molder 2006b, 45]. Amadeo acquired this book in 1907 and it can be consulted in the artist's estate at BA-FCG.
[167]Cf. Flaubert 2005, 74 (Translation of the excerpt by the author of this dissertation).
[168]Cf. Part III of the tale *La Légende de Saint Julien l'Hospitalier*.
[169]In a letter to Lucie from 1910, Amadeo expressed his profound sadness with the fall of monarchy [BA-FCG (ASC 12/13)].

✣ Castle of Vitré

No document was found that can prove that Amadeo de Souza-Cardoso traveled to Vitré during the summer holidays spent in Brittany in 1912. However, it was one of the cities that the painter visited in 1907, as mentioned in ***Chapter 1***, ***section 1.1***.

In the illustration of *La Légende* it is observable that the young painter was inspired by the architecture of the castle of Vitré in the representation of Julien's father's castle which is also located *on the slopes of a hill*[170]. Amadeo's visual territory was definitely marked by the atmosphere of Brittany[171].

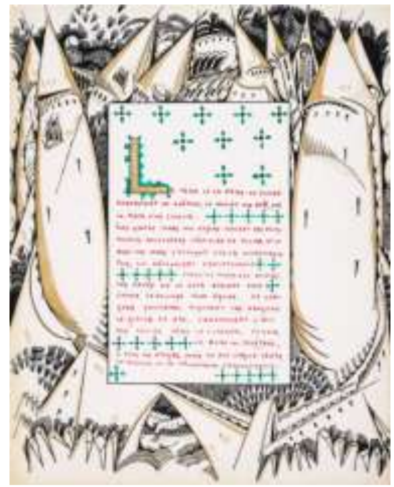

Figure 2.24. *On the left*: Postcard from Amadeo's time, presenting the castle of Vitré. *On the right: La Légende de Saint Julien l'Hospitalier* (1912), p. 51, MG-MC.

✣ Amedeo Modigliani

Chapter 1 referred the close friendship and artistic complicity that joined Amadeo de Souza--Cardoso and Amedeo Modigliani during the Portuguese artist's early career. Helena de Freitas observed that both artists had besides the same first name in common, *the haughty and aristocratic posture, the good looks and determination* [Freitas 2008, 424]. Moreover, in the artistic point of view, in that period (1909-1912) Souza-Cardoso and Modigliani were also interested in ancient art, the art of other cultures and Cubism. Freitas also observed, *that maybe because the drawing is first formed in the thoughts and mind of the artist and because the artist [Amadeo] was at ease in this discipline, he tried new ways of aesthetic that coincided with his close relationship with Modigliani and his circle of friends* [Freitas 2008, 424].

[170]Cf. Flaubert 2005, 49 (Translation of the excerpt by the author of this dissertation).

[171]Amadeo's friend, Manuel Laranjeira, in a letter from October 17, 1907 observed the effect that the Brittany panoramas caused in Amadeo: *It's amazing how much everyone worships that superstitious and legendary Brittany. Even you seem to have taken roots in that holy land* [apud Alfaro 2007, 288] (Translation by the author of this dissertation). In 1912, Amadeo seemed already artistically interested in such panoramas as mirrored in *La Légende*.

Is worth to refer that, in the same period, Modigliani was working in sculpture, encouraged by Brancusi, who also became friend of Amadeo, as already referred in ***Chapter 1***, ***section 1.1*** [Gonçalves 2006, 16]. Modigliani was not interested in impressionist sculpture, modeling or in Rodin's and Medardo Rosso's works [Cazals 2013, 32]. The discovery of the African tribal masks generated the foundation of several ethnographic museums in Europe, between 1907 and 1910. Consequently, this fact promoted the interest by many artists, as Picasso, in such artefacts [Barros 2011, 39]. Modigliani also found interest in the so called "Primitive" and archaic art [Del Puppo 2011, 6]. The Italian artist's works are characterised by the seriousness mien, presenting a long neck like a column, sometimes, the head tilted and the slander eyes which look as having no expression. Amadeo's interest for the Modigliani's work was notorious [Freitas 2006, 27]. In fact, beyond *La Légende de Saint Julien l'Hospitalier*, other drawings in that period show this same influence[172].

Figure 2.25. Photos by Amadeo of Modigliani's works, BA-FCG. *On the left*: Caryatide. *On the right:* one of his "heads", BA-FCG (photos by the author of this dissertation with the permission of FCG).

A set of photos of Modigliani's sculptures (heads of women) probably taken by the Portuguese artist and also a drawing of a caryatide[173] (***Figure 2.25***) were found in Amadeo's estate at BA-FCG. However, in *La Légende*, the "modiglianesque" drawing stroke disappeared, in comparison with the album *XX Dessins* as referred in ***Chapter 1**, **section 1.2.1***. Souza-Cardoso is a self-taught artist [França 2011, 177]. In *La Légende*, the influence of Modigliani is visible in the representation of some faces as masks and in the illustration of Julien's mother (***Figure 2.26***). The long neck finds similarity with those of Modigliani's sculptures and the figure's look is also without any expression.

Figure 2.26. *La Légende de Saint Julien l'Hospitalier* (1912), p. 21, MG-MC.

The discreet influence of Amedeo Modigliani in this manuscript reflects an important characteristic of Amadeo's oeuvre: *he progresses on the shape, exploits them as a support for a research and immediately passes on to other influences*[174]*.*

[172]This fact is mentioned by Maria Filomena Molder [Molder 2006b, 25].

[173]Cf. Grenier 2016, 29. Helena de Freitas also referred that Amadeo received or exchanged some drawings with Modigliani [Freitas 2006, 27].

[174]Cf. Freitas 2006, 27 (Translation of the excerpt by the author of this dissertation). Moreover, this behaviour became part of Amadeo's style. In his words to *Jornal de Coimbra* (December 21, 1916): *(...) everything I have done is different from the previous work and always more perfect* [Cf. Freitas 2006, 67].

Early Russian *avant-garde*

Helena de Freitas mentioned that the data that allows establishing a connection between Amadeo de Souza-Cardoso and the Russian[175] *avant-garde is short but precise* [Freitas 2006, 59]. In fact, attentive to the Parisian novelty, the first contact that the artist had with the Russian art probably occurred soon after his arrival in the "City of Light" in November 1906. In that period, the *Salon d'Automne* was holding the *Exposition de L'art Russe* (17th and 18th centuries) curated by the future director of *Ballets Russes*, Sergei Diaghilev [Alfaro 2006, 431]. According to the catalogue of this exhibition 750 pieces of 103 artists (among them Léon Bakst, Alexandre Golovine, Natalia Goncharova and Mikhail Larionov) and 35 religious icons (from the 15th until the 17th century) were shown[176]. Furthermore, the art historian Jean-Claude Marcadé pointed out that Souza-Cardoso certainly visited in the *Salon des Indépendants* of 1910 and 1911, the works of Mykhailo Boichuk (1882-1937) and from his "neo-Byzantine" school. The author cited Guillaume Apollinaire in *L'intransigeant* (April 22, 1911) about the works of these artists, whose ambition was to keep intact the religious painting traditions of the *Little Russia* (now, Ukraine): *They fully succeeded in their mission and their well-finished, well-drawn works have an accomplished Byzantine quality about them. They also applied the same simplicity, gold backgrounds and artistic finesse to small, more modern pictures*[177].

In the rendition of *La Légende de Saint Julien l'Hospitalier*, the strong visual inspiration on the Russian religious iconography (especially those from the 15th until the 16th century) seems evident, not only in the stylised and elongated way of representing the human body (this observation can also refer to the Gothic art) but also in the application of colour (especially, gold and silver) which provide the sense of sacred in the illustration of Saint Julian the Hospitaller's story[178] (***Figure 2.27***). Other examples can be found in ***Appendix A2.9***.

Figure 2.27. *From left to right:* Theotokos of Vladimir (12th century). Source: Tretyakov website: http://www.tretyakovgallery.ru/. *La Légende*: p.21 and 35, MG-MC.
John of the Ladder, abbot of St. Sinai (13th century). Source: http://www.ruicon.ru/

[175]It refers to the natives from the Russian Empire.
[176]Cf. Catalogue *L'art Russe* 1906.
[177]Apollinaire 1911 apud Marcadé 2006, 363.
[178]It is worth referring that the church of *Saint Julien le Pauvre* in Paris – that Amadeo probably knew – is an Eastern Catholic Melkite parish since 1889. One can contemplate religious icons inside this church.

The influence of the Russian religious iconography is also present in the so called "Neo-primitivism", as mentioned in ***section 2.2***. Thus, this source of inspiration is the main linkage established between *La Légende de Saint Julien l'Hospitalier* and some Russian *avant-garde* artists' books[179]. In Amadeo's illustration, the inspiration on this iconography also contributes to a mystic and orientalism side in this work[180].

Elements from Cubism and Futurism are intrinsic to "Neo-primitivism", as also referred in ***section 2.2***. In *La Légende*, they are observable too, fruit of Amadeo's graphical evolution as explained in ***section 1.2.1***. Examples of the revolutionary Cubism[181] and the dynamic character of Futurism are presented in ***Figure 2.28***. Note that the geometric shapes were a common form of artistic representation at the time, especially in the context of Cubo-Futurism [Marcadé 2006, 371].

Figure 2.28. *From top to bottom: La Légende* (1912), p. 47, 134, 30 and 97, MG-MC.

Henri Rousseau, *Le Douanier* and the modern "Primitivism"

Maria Filomena Molder briefly referred to the influences of Henri Rousseau on *La Légende de Saint Julien l'Hospitalier* production. As mentioned in ***section 1.2***, the Portuguese artist revealed interest in Rosseau's works, during the exhibition held in 1911 at the *Salon des Indépendants*. Paulo Ferreira also mentioned that Amadeo admired his *formal simplicity* and sense of composition [Ferreira 1995, 126]. In *La Légende*, the representation of elements from nature – which can also allude to the panoramas of Manhufe, Amadeo's beloved homeland – seems also to find meeting points in Rousseau's naïf paintings. In particular, this influence is observable in the representation of fauna and flora, involved in an exotic and fantastic atmosphere[182] (***Figure 2.29***).

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[179] *See Appendix A2.2*. This influence is also reported by Helena de Freitas in some of Amadeo's later paintings [Freitas 2006, 59].
[180] Amadeo had interest in religious literature. In his estate at BA-FCG it was possible to found books as *Imitation of Christ* and the *Confessions* of Saint Augustine. Moreover, at the end of his life, in 1918, he painted two untitled works which are called *Stigmatisation of St. Francis a*nd *Sacred Heart of Jesus* [Cf. Freitas 2006b (nº250 and 251)]. In a letter to Lucie from November 1913, Amadeo expressed his admiration for the Bible [BA-FCG (ASC 12/56)].
[181] The *Salon des Indépendants* of 1911 is considered the first great cubist exhibition [Alfaro 2007, 140].
[182] Rui-Mário Gonçalves referred that Amadeo, Modigliani and Brancusi admired Rousseau's *oeuvre*. Moreover, when Amadeo once visited Brancusi's studio he commented: *I understand what Henri Rousseau wanted. He wanted to transform the ancient to modern* [apud Gonçalves 2006, 16] (Translation by the author of this dissertation).

Figure 2.29. *From left to right: Le Douanier* Rousseau, *Combat de tigre et de buffle* (1908-09). Source: State Hermitage Museum website : http://www.arthermitage.org/. *La Légende*: p. 84 and 80, MG-MC.

✤ Robert Delaunay's contrast of colours

From all Souza-Cardoso's works in his early career (1907-1912), *La Légende* is definitely the most colourful, as can be confirmed in Volume II of the Catalogue *Raisonné*. It is quite possible that the strong contrasts of colour, found there were fruit of Amadeo's learning from the contact with Robert Delaunay. In particular, the influence of Delaunay's *simultaneity*, which was based on the 19th century colour theories of Chevreul and Rood, seems evident in *La Légende* [Ball 2012]. This concept was related with the use of complementary colours to develop an idea of "colour movement". Delaunay defended that complementary colours put side by side produce "slow" movements whereas colour wheel, such as orange and yellow or blue and green, produce "fast" movements [Ball 2012]. As referred by the author Tom Slevin, *Colour gives depth (not perspective, non--sequential, but simultaneous) and form and movement* [Slevin 2015, 104]. These were the ideas in the basis of Orphism (Cubism Orphic). In *La Légende,* this colourful and beautiful resource imparts certain dynamism to the perception of Flaubert's tale, as observable along the reading of the text in the manuscript[183]. For instance, the contrast of colours present in p.97 (***Figure 2.28***) shows the dynamism previously referred. This resource accompanied Amadeo in other works after *La Légende de Saint Julien l'Hospitalier*.

Figure 2.30. *On the left:* Robert Delaunay, (without title and unknown date). *On the middle: La Légende de Saint Julien l'Hospitalier* (1912), p. 137; *On the right: Mucha* (1915), MG-MC.

[183]Amadeo was sensitive to colour. As mentioned by Almada Negreiros, *his oeuvre reflects his homeland* – Manhufe – like *poetry of colours* (Cf. Negreiros 1959 apud Freitas 2008b, 59-60). To Lucie, Amadeo wrote in 1910: *You cannot imagine how this land is full of colour, joy, soul, intensity. Sometimes it is even mad* [BA-FCG (ASC 12/06)] (Translation by the author of this dissertation).

An example is presented in ***Figure 2.30***. This discussion will be complemented with the results presented in ***Chapter 4, Section 4.7***.

The *ex-votos*

In *La Légende de Saint Julien l'Hospitalier* some small hearts are painted reminding *ex-votos*[184]. These decorative elements seem also inspired in the folk art that Amadeo appreciated. This expression of popular religiosity is a votive offering to Christ, to the Virgin Mary or to a saint in gratefulness of a vow or in renewal of the same. They are usually found in churches (e.g. cathedral of Chartres – *see **Appendix A2.10***). As mentioned by the art historian Raquel Henriques da Silva, during his stays in Manhufe, Souza-Cardoso used to visit his friend, the poet Teixeira de Pascoaes on horse-back[185] in his house in Gatão (c. 12 Km from Manhufe). Pascoaes owned a great collection of *ex-votos* (***Figure 2.31***) [Araújo 2012, 8].

Figure 2.31. *On the left: La Légende*: p.135, MG-MC. *On the right: Ex-voto* of the Sacred Heart of Jesus, belonging to Teixeira de Pascoaes [Araújo 2012, 22].

The Flemish "primitives"

The interest that Amadeo showed for these artists' works has already been discussed in this dissertation [*see* ***Chapter 1, section 1.1***.]. Consulting the catalogue of the exhibition of ancient art *L'Art Belge au XVII^e^* that Amadeo visited during the *Exposition International de Bruxelles* in 1910[186] [Catalogue Exposition International de Bruxelles 1910], it is possible to verify that the representation of riders and hunting scenes in several pieces certainly caught Amadeo's attention[187].

Figure 2.32. *On the left:* Pieter Boel, *Étude de tête de cerf* (17th century) Source: RMN-Grand Palais (musée du Louvre) website: http://art.rmngp.fr. *On the right: La Légende*: p.84, MG-MC.

[184]Cf. p.88 and 135 in *Appendix A1.1*.
[185]Cf. Documentary *Amadeo de Souza-Cardoso – À velocidade da Inquietação* (©Panavídeo Produções, Portugal, 2013).
[186]The catalogue of this exhibition presents indicates 115 pieces [Cf. Catalogue Exposition International de Bruxelles 1910].
[187]As referred by Catarina Alfaro and Maria Filomena Molder, the artist paid attention to those representations finest Belgian tapestries (Gobelins) that, at the time, decorated the interior walls of the *Château de Keriolet* in Concarneau [Molder 2006, 15; Alfaro 2007,161] .

Moreover, in the illustration of *La Légende de Saint Julien l'Hospitalier*, there is some affinity between the representation of the deer with a drawing by Pieter Boel (1622-1674) entitled *Étude de tête de cerf* [Study of the head of a deer] (***Figure* 2.32**) present in the referred exhibition. Furthermore, according to information obtained from the Louvre Museum website, where this drawing is kept, it served as model to the production of Gobelins tapestries[188].

The interest showed in the Flemish "primitive" artists followed Amadeo during his early career. When in Manhufe, he used to ask Lucie to buy some postcards of these artists in Paris, as it can be confirmed from his letters[189].

✣ Medieval codices

According to António Rodrigues, the attraction for *fantastic stories of the Middle Ages* led the Portuguese artist to illuminate *La Légende de Saint Julien L'Hospitalier* by Flaubert. Moreover, as also mentioned by this author, in a letter to his uncle Francisco from 1910, Amadeo praised the medieval artists for whom he considered *art was more a portrait of one's soul than the model itself* [190][Rodrigues 1987, 24].

Figure 2.33. *On the left: Annunciation* from a Book of Hours, c. 1470 (IL42, fl.22), BNP.
On the right: La Légende: p.80, MG-MC.

[188]This detail seems to establish a visual connection between this piece and the tapestries that Amadeo contemplated in 1912 at the *Château de Keriolet*.

[189]From a letter from Amadeo to Lucie: *Regarding the photograph of the 'primitive – the procession – I don't want it; it's too expensive. Please buy me the other one, the portrait of the lord with two cornered hat* [Cf. BA-ASC 12/03] (Translation by the author of this dissertation).

[190]Translation by the author of this dissertation.

In Amadeo's artistic production, the hypothesis of revivalism and mimicry is definitely not present[191]. The medieval world is convened from a tale centred on Saint Julian Hospitaller and is revealed in the way the book is structured, in the relationship between the text and images (***Figure* 2.33**), in the role played by the margins and also in the symbolic heraldic function and bestiary. Other features that recall the medieval manuscripts in *La Légende* are represented by the capital letters[192]. In Amadeo's work, they are simpler respect to those of the medieval codices. Nevertheless, they are elaborated (***Figure* 2.34**). Other similarities are found in the division of the chapters, using Roman Numbers and the respective decoration (***Figure* 2.35**), as well as in the end-of-the lines present in some pages (***Figure* 2.36**), which date to the Books of Hours productions[193].

Figure 2.34. Comparison between the capital letters from a medieval illuminated manuscript (Alc. 54, fl. 151 and Alc. 66, fl. 100v), BNP (*on the left*) and from *La Légende*, MG-MC (*on the right*).

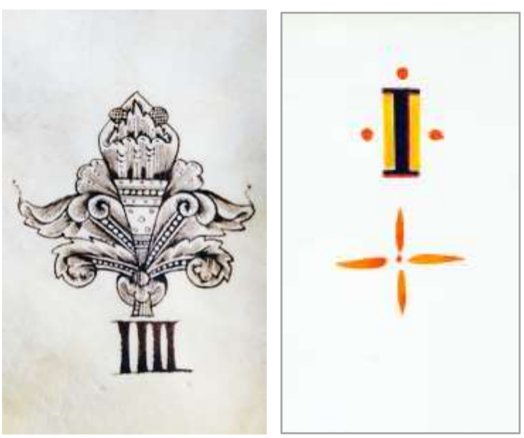


Figure 2.35. Division of the chapters, using Roman Numbers. *On the left*: Portuguese Romanesque codex *Legendarium*, 12th century (Alc. 421, fl. 33v) [detail], BNP. *On the right: La Légende*: p. 48 [detail], MG-MC.

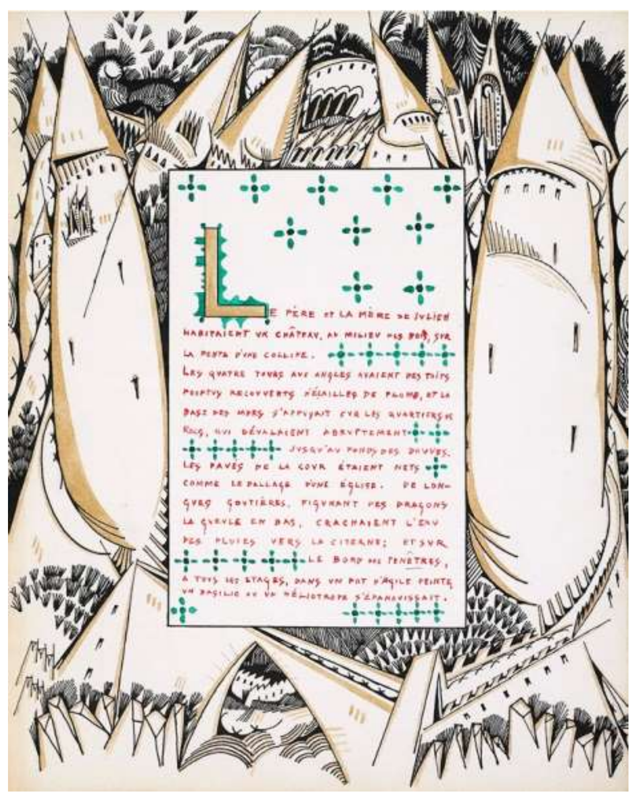


Figure 2.36. Example of end-of-lines in *La Légende* (p.51), MG-MC.

[191]In a letter to his uncle Francisco, from 1910, Amadeo expressed his ideas about it: *Intelligent seems the one that, despite appreciating a work of art, rightly does not want to imitate it. A true artist owns something that only belongs to him and to no one else* [apud Alfaro 2007, 133] (Translation by the author of this dissertation).

[192]It is also interesting to observe that André Derain also decorated the capital letters of his *livre d'artiste L'Enchanteur pourrissant* (1909) [*see Appendix A2.2*].

[193]Cf. *Figure 2.33* on the left. Other examples are presented in *Appendix A2.11*.

Figure 2.37.
Detail from a Book of Hours
(15th century) (Ms LA 144, fl.15v), MG-FC.

Prayer was central in medieval life as art was [Wieck 1988, 39]. Despite their beauty, the Books of Hours were used as prayer books for ordinary lay people in the 14th and 15th centuries who desired to sanctify their journey following the liturgical calendar [Wieck 1988, 41; Araújo *et al.* 2015]. The owners of Books of Hours were usually wealthy people (queens, dukes or noblemen) who ordered these small manuscripts in *ateliers* of urban centres of France and Flandres [Wieck 1988, 39; Araújo *et al.* 2015]. There was an effort to personalise a Book of Hours which was designed according to the patron's artistic and devotional tastes and economic power [Wieck 1988, 39; Araújo *et al.* 2015]. It could include other prayers dedicated to the Virgin Mary and saints [Wieck 1988, 42]. As stated by Roger S. Wieck, *a Book of Hours is a cathedral that you can hold in your hands (...) an elaborated Gothic cathedral of prayers and images*[194] [Wieck 1988].

However, for some owners, possessing a Book of Hours was a sign of prestige. Their family name was signed, the respective coats of arms inked and they chose their favourite prayers to be included in it [Wieck 1988, 39; Araújo 2012b, 2].

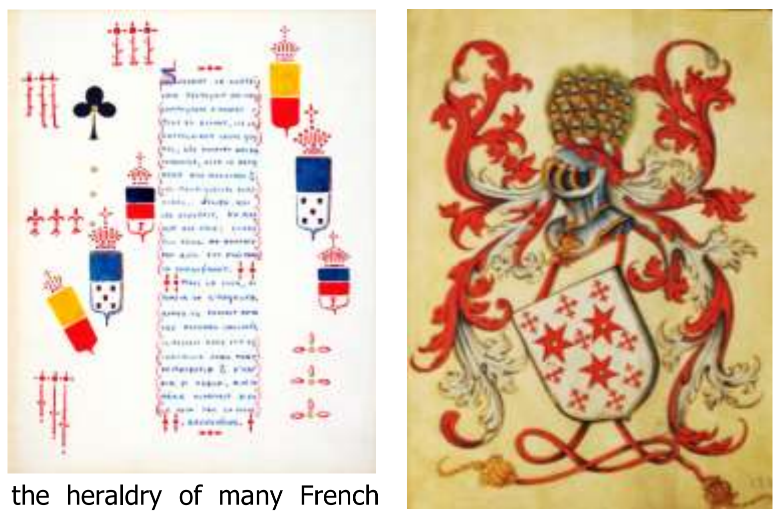


Figure 2.38. *On the left:*
La Légende: p.65, MG-MC.
On the right: Representation of the coat of arms of the family that ordered this Book of Hours, 15th century (Ms 23, fl.129), PNM.

Amadeo nourished an interest for coats of arms. As a matter of fact, during the year 1912, the artist also produced a set of drawings regarding the heraldry of many French cities[195]. Moreover, in 1913, the Portuguese painter ordered a certificate of his own nobility[196] to the *Academia Heraldica* in Paris [*see* ***Appendix A2.12***]. In *La Légende de Saint Julien l'Hospitalier*, this heraldic fantasy is reflected in many pages which are decorated with coats of arms being evinced by their strong chromatic contrast. The presence of these aristocratic decorative elements seems also to refer to a connection with the medieval Books of Hours[197] (***Figure 2.38***).

[194]This metaphor reminds the one used in *section 2.2* where *La Légende* was compared to a house that one can visit.
[195] Some drawings referred to the heraldry of Brittany' cities are presented in *Appendix A2.12*.
[196] According to Diogo de Macedo, Amadeo said he descended from nobility with the right to a coat of arms [Macedo 1959].
[197] More examples can be found in *Appendix A2.12*.

La Légende de Saint Julien l'Hospitalier shows other similarities with the Books of Hours, especially the Flemish ones. According to the researcher Thomas Da Costa Kaufmann, *tromp l'oeil* illumination was one of the most remarkable phenomena in European painting of the 15th and 16th centuries. In that period, nature assumed an important role and artists tried to imitate it in the manuscripts [Kaufmann 1993, 11]. Plants, flowers, seeds, nuts, insects and also reptiles such as snakes or lizards were painted in detail in rich colours by means of watercolour technique, decorating the margins of the folios (***Figure 2.39***) [Kaufmann 1993, 13].

Figure 2.39. Examples from Books of Hours. *From left to right*: *Saint Christopher*, Flanders, c. 1440-1450 (Harley MS 2846, fl. 38v), BL; Hours of Engelbert of Nassau, Flanders, c. 1470-1490 (MS. Douce 219 fl. 152v and 139r, respectively). Source: http://bodley30.bodley.ox.ac.uk/. Last accessed on November 11, 2016.

Amadeo de Souza-Cardoso in *La Légende* also paid attention to Botanic in the illustration, eventually inspired not only by Henri Rousseau but also by the referred medieval codices. The artist introduced elements from nature with ornamentation function of some pages[198], as well (***Figure 2.40***).

Figure 2.40. *La Légende* (p. 80, 66 and 61, respectively), MG-MC.

[198]Thus, in what concern the representation of nature in *La Légende*, the possibility of an influence of Flemish Books of Hours seems more adequate rather than the *Art Nouveau* and *Jugendstil* mentioned by Joachim Heusinger von Waldegg [*see Chapter 1, section 1.3*]. Maria Filomena Molder also disagrees with this possibility as referred in *section 2.1.2* [Cf. Molder 2006b, 48].

Regarding the handwritten text, the artist organized it in several ways in the book. As can be observable in some pages presented in this section, the text was encrusted in a frame, surrounded by decorative elements (Gothic style). On other pages it is organised as having an invisible frame (***Figure 2.41***).

Figure 2.41. *La Légende* (p. 97, 88 and 128, respectively), MG-MC.

The text can even assume the shape of an image (Romanesque style), which aspect is exploited or in the medieval codex or in Amadeo's modern art. It is therefore, a millennial process that organises text in images, which reaches in an extreme impact in visual contemporary poetry[199] (***Figure 2.42***).

Figure 2.42. *From left to right*: *The Cedar of Lebanon* (Santa Cruz (12th century), Ms. 34, fl 94v), BPMP; *La Légende* (p. 84), MG-MC; and 'visual poetry' by Jorge Castro[200].

[199]More examples can be found in *Appendix A2.12*.
[200]Image publication kindly allowed by the poet.

Colour is an important aspect in *La Légende de Saint Julien L'Hospitalier*. Gold and silver paints were profusely applied in particular in the synopsis. In medieval illuminated manuscripts, both colours are symbols of light and wealth and were applied in areas that aimed to stand out for its majesty as the halos of saints and generally in multiple decorative elements as sources of light (***Figure 2.43***). It is also observed in Amadeo's manuscript. The application of gold seems to be associated to the fact that Flaubert's tale, that he copied and illustrated, deals with the story of a saint. On the other hand, silver is mainly applied on the coats of arms and in Saint Julian's final halo represented as a moon. Thus, the application of these noble colours in *La Légende* assumes a connotation related with the sacred. This fact is also in consonance with the primitive Russian religious iconography, which often presents a background painted with gold [Kondakov 2012, 97]. Souza-Cardoso, who had contact with Russian art, was certainly aware of this particularity of that iconography.

Figure 2.43. *From left to right*: Example of the application of gold in a medieval manuscript. *René II of Lorraine kneeling in prayer before the Blessed Virgin Mary and Child*, Paris, c. 1473-1479 (Ms LA 147, fl.10), MG-FC; *La Légende* (p. 24 and 136, respectively), MG-MC.

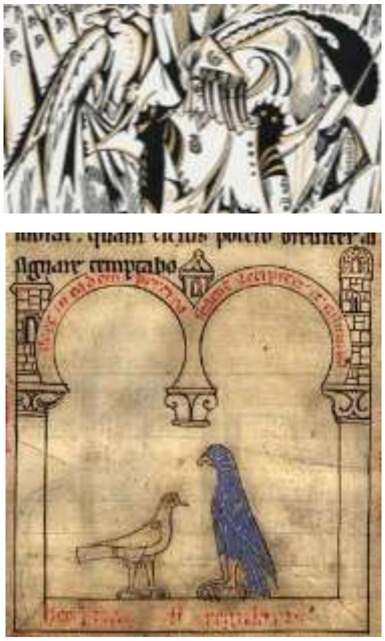
The pictorial palette used by Amadeo in the rendition of *La Légende de Saint Julien L'Hospitalier* possesses vibrant colours just like the medieval manuscripts[201], provided by violet, blue, green, red, orange, yellow, ochre, Bordeaux and black paints. Despite the diverse influences and variety of graphical languages, colour establishes an important role of granting unity and homogeneity in the artist's expression in this work[202]. Following the paradigm of recent studies carried out at DCR-FCT-UNL on the meaning of colour in Portuguese medieval illuminated manuscripts, in ***Chapter 4, section 4.7***, the results of the colour mapping of *La Légende* will be presented with the objective of understanding if the chromatic richness used by Amadeo has a symbolism as in the medieval codices.

[201]Probably, from the influence of Robert Delaunay, as previously, referred or even, from the lessons from Anglada Camarasa (1909).
[202]In comparison with the monochromatic drawings of the album *XX Dessins*, the consistent colour palette used by Amadeo in *La Légende* brings out this evidence.

Amadeo's bestiary

In *La Légende de Saint Julien L'Hospitalier*, the representation of animals reminds a more ancient medieval tradition – Romanesque – where the bestiary was used as ornament and symbol.

Falcon (*Falconiforme*)



As previously indicated in ***Chapter 1***; ***section 1.3.1***, falcon (***Figure 2.44***) is one of the attributes of Saint Julian the Hospitaller [Heinz-Mohr 1995, 155]. Amadeo associated it to the illustration of Julien as being rapacious and a brave hunter, who saw himself as *a falcon that desires to catch and dilacerate the prey, defile it to nothing and return to the gauntlet of his lord*[203]. In the medieval bestiaries this carnivorous bird is symbol of nobility and even of a converted noble[204]. These aspects are in agreement with the figure of Julien.

Figure 2.44. *On top: La Légende* (detail p.30), MG-MC.
Bellow: *The Dove and the Falcon* (Lorvão 5, fl.2r), DGARQ-ANTT.

Deer (*Odocoileus virginiana*)

This is an important figure of the tale and Amadeo gave a particular attention to its representation in the illustration (***Figure 2.45***). Actually, after the great bloodshed narrated at the end of the first part of the tale, a deer after being hit by Julien, predicted the parricide. *Damned! Damned! Damned! One day, oh ferocious heart, you will murder your father and your mother!*[205] Quoting Isidore of Seville, Willene B. Clark refers that deer is enemy of serpent (which in this context represents evil) [Clark 2006, 134]. Thus, it is symbol of benevolence and persecution by the malign [Heinz-Mohr 1995, 96].

Figure 2.45. *On the left:* Deer (Harley, Ms 4751, fl.14v), BL. Source: Medieval Bestiary Archive 2011. *On the right: La Légende* (p. 84), MG-MC.

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[203]Cf. Flaubert 2005, 56 (Translation of the excerpt by the author of this dissertation).
[204]Cf. Folieto 1999.
[205]Cf. Flaubert 2005, 60 (Translation of the excerpt by the author of this dissertation).

Serpent (*Serpentes*)

No! No! No! I can't kill them! And what if I wanted to? And was afraid that the devil would inspire him to do so[206]*.* In the Holy Scripture, the serpent (***Figure 2.46***) symbolises evil, the tempter that led Adam and Eve to sin (Gn 3, 1-5). However, in the medieval bestiaries, the snake shedding its skin reminds the idea of conversion, of crossing the "narrow way to salvation" – Christ [*The Medieval Bestiary* 2011]. In the context of Amadeo's *La Légende de Saint Julien l'Hospitalier*, the serpent may have these two meanings: the tempter that is present since the beginning of the illustration until the night of the parricide[207], or symbol of metamorphosis, as proposed by Maria Filomena Molder[208] since it changes its skin in spring [Heinz-Mohr 1995, 314].

Figure 2.46. *On the left:* Serpent (6838B, fl. 35r), BNF. Source: Medieval Bestiary Archive, 2011. *On the right: La Légende* (detail p. 74), MG-MC.

Ermine (*Mustela erminea*)

In the heraldry of Brittany, the ermine is profusely represented [*see* ***Appendices A2.1 and 2.12***]. Moreover, as pointed out by Maria Filomena Molder[209], the referred heraldry plays an important role in Amadeo's illustration. In ***Figure 2.47***, one of these examples is shown which finds formal meeting points with the representation of this same animal in *La Légende de Saint Julien l'Hospitalier*. According to literature, the ermine belongs to the family of weasels. During the winter, this beast presents a white coat with a black tail [Burton and Burton 2002, 787]. The white ermine is symbol of purity and innocence. It reminds the small white mouse that Julien killed when he was a child and at the same time Julien's mother (*who was very pale*'[210]) – a presage of the parricide, as referred by Loïc Windels [Windels 2010]. The white will be profaned with the parricide.

Figure 2.47. *On top: La Légende* (p. 101), MG-MC.
Bellow: Representation of the flag from Vannes (Brittany).

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[206]Cf. Flaubert 2005, 61 (Translation of the excerpt by the author of this dissertation).
[207]p.52, 55, 74 and 93 in *Appendix A1.1*.
[208]Cf. Molder 2006, 21.
[209]Molder mentioned in the essay that a weasel is represented in this page of the manuscript [Molder 2006, 35]. However, as referred, it finds more affinity with the ermine.
[210]Cf. Flaubert 2005, 50 (Translation of the excerpt by the author of this dissertation).

The ermine is one of the animals present in Julien's dream, when he sees himself in the role of Adam in Paradise surrounded by animals, but killing each one of them. The Portuguese painter depicted the ermine in black (the "inversed" colour of white) as represented in the Brittany heraldry, where the ermines are represented in a white field ( ), alluding to the terrible crime.

Weasel (*Mustela nivalis*)

Figure 2.48. *On the left:* Weasel (14429, fl. 112v), BNF. Source: Medieval Bestiary Archive, 2011. *On the right: La Légende* (p. 81), MG-MC.

In the medieval bestiaries, this beast is represented as a long and thin animal (***Figure 2.48***). It conceives by mouth and gives birth through the ear and symbolises people who hear the word of God but don't correspond in their attitudes. This seemingly innocuous little creature is a voracious killer and eats especially mice and snacks [*The Medieval Bestiary* 2011]. Amadeo de Souza-Cardoso represented the weasel in the page that narrates the bloodshed of the deer, portraying Julien as insatiable killer.

Hedgehog (*Atelerix Albiventris*)

Figure 2.49. *On the left: La Légende* (p. 80), MG-MC. *On the right:* Hedgehog (Ms. Bodley 764, fl. 52v), Bodleian Library. Source: Medieval Bestiary Archive, 2011.

Citing Isidore of Seville, Clark indicates that the hedgehog is an animal (***Figure 2.49***) that shows a certain practical wisdom. When it perceives any kind of attack or danger it defends itself within its quills, having rolled into a ball [Clark 2006, 162]. In other source refers that it hunts serpents, so it is also considered an enemy of evil having a positive connotation [Heinz-Mohr 1995, 298].

The presence of this animal in Amadeo's manuscript illustrates the ambience in the forest. The hedgehogs are some of the beasts mentioned in this page. The artist illustrated them with frightened eyes due to the presence of Julien in the forest. Moreover, this small mammal usually is represented climbing a vine or rolling in fruit (as grapes or apples) [*The Medieval Bestiary* 2011]. The Portuguese artist also took into account this aspect in his illustration.

Badger (*Mustelidae*)

Pliny the Elder, cited in *The Medieval Bestiary* 2011, indicated that this beast protects itself from an attack by inflating and distending its skin (***Figure 2.50***). In certain contexts it symbolises the capital sin of avarice [Heinz--Mohr 1995, 329]. Amadeo illustrated the badger as one of the animals present in the forest as described by Flaubert.

Figure 2.50. *On the left:* Badger (Ms. Bodley 764, fl. 50v), Bodleian Library. Source: Medieval Bestiary Archive, 2011. *On the right: La Légende* (p. 82), MG-MC.

Wolf (*Canius Rufus*)

According to medieval bestiaries, wolf (***Figure 2.51***) is considered as a greedy animal seeking blood and naturally associated with the devil [Clark 2006, 142; Heinz-Mohr 1995, 211]. Clark cited Solinus who referred: *The devil, which always look malignly at the human race, and constantly circles the sheepfolds of the Church's faithful in order to afflict and destroy their souls, is like a wolf* [Clark 2006, 143]. In the illustration, Amadeo de Souza-Cardoso depicted Julien with wolves, emphasising the bravery of the *damned hunter* who *defended himself from wolves who devoured corpses*[211].

Figure 2.51. *On the left:* Wolf (Ms.1951, fl. 4v), BNF. Source: Medieval Bestiary Archive, 2011 *On the right: La Légende* (p. 76), MG-MC.

[211]Cf. Flaubert 2005, 57 (Translation of the excerpt by the author of this dissertation).

Goat (*Capra Aegagus Hircus*)

The medieval meaning of the goat (***Figure 2.52***) is Christ himself. As goat loves mountains in the same way Christ loves His Church [*The Medieval Bestiary* 2011]. Goat is a victim of the devil, as Jesus was betrayed by Jude [Collins 1913, 12]. In *La Légende*, goats are victims of Julien's ferocity.

Figure 2.52. *On the left:* Goat (Royal Ms. 12C. xix, fl. 31v), BL. Source: Medieval Bestiary Archive, 2011. *On the right: La Légende* (p. 78), MG-MC.

Peacock (*Pavo Cristatus*)

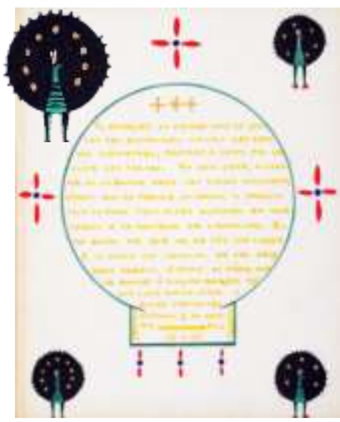


Figure 2.53. *On the left:* Peacock (Ms. 993, fl. 159r), BMR. Source: Medieval Bestiary Archive, 2011. *On the right: La Légende* (p. 89), MG-MC.

Molder mentioned that in the Middle Ages, peacock (***Figure 2.53***) was a symbol of immortality and incorruptibility of the soul. This author also observed that the feathers of the tail of the peacock when it is opened are comparable to the eyes of the several animals that follow Julien in the forest, the night before the parricide [Molder 2006, 32]. This bird is traditionally a symbol of pride [Windels 2010]. In fact, as root of all vices and sins, it was pride that blinded Julien in all his actions, both as a fierce hunter, as in the night of the parricide, when he sees two bodies lying in his own nuptial bed and kills them unmercifully. According to medieval bestiaries, the voice of peacock is terrible and causes fear to the listener, especially, when it begins to cry. It also symbolises the voice of the preacher who warns sinners of their end in hell [*The Medieval Bestiary* 2011]. In Amadeo's illustration, the peacock is represented after the episode of the prophecy of the deer. At his father's castle, during the sunset, Julien saw a stork and was prepared to kill it. At that right moment, he ears the voice of his mother screaming (because her dress *with long fringes was stuck on the wall*[212]). Petrified and horrified at the thought of killing his own mother, Julien ran away home. So, in this context, Amadeo also represented the peacock referring to Julien's mother (*a bit haughty and serious*[213]).

[212]Cf. Flaubert 2005, 62 (Translation of the excerpt by the author of this dissertation).
[213]Cf. *Idem*, 50.

Owl and Bat (*Otus jolandae et Chiroptera*)

Owls (***Figure 2.54***) fly at night and cannot be seen during the day, because their vision is dimmed by the brilliance of the sun [Clark 2006, 178]. It is also associated with message of death and the symbol of spiritual obscurity [Heinz-Mohr 1995, 106]. The bat is also associated with the night [Clark 2006, 182]. It represents evil too [Heinz-Mohr 1995, 287] Despite the fact that it is not mentioned in the tale, Amadeo de Souza-Cardoso represented these animals as one of those that were watching Julien in the forest, during the night before the parricide.

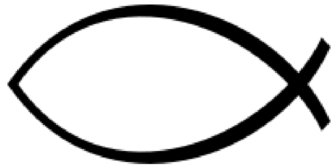
Figure 2.54. *On the left:* Owl (Ms. 993, fl. 158r), BMR. Bat (Ms. 993, fl. 160r), BMR. Source: Medieval Bestiary Archive, 2011.*On the right: La Légende* (p. 113), MG-MC.

Cat (*Felis Domesticus*)

This animal is considered an enemy of mice. It possesses very good eyesight that can penetrate in the darkness of night [*The Medieval Bestiary* 2011]. Amadeo also represented the cat (***Figure 2.55***) as one of the beasts that observes Julien in the forest, the night before the parricide. The fact is dramatized in the illustration through the silver shiny colour in which the eyes of the animal were painted.

Figure 2.55. *On the left: La Légende* (p. 119), MG-MC.
On the right: Cat (Ms. Ashmole 1462, fl. 58v), Bodleian Library.
Source: Medieval Bestiary Archive, 2011.

Fish (*Pisces*)



According to the Christian tradition, the fish (***Figure 2.56***) was often represented since the very earliest centuries. The *Ichthys*[214] symbolises Christ and Christian and was used especially in the Roman catacombs during the times of persecution. This symbol is also used in close connection with the waters of Baptism or related with the miracle of the *Draught of Fishes* carried out by Jesus. Sometimes, three fishes are depicted together symbolizing the Holy Trinity [Collins 1913, 25]. Souza-Cardoso represented the fish in the illustration associated with the process of Julien's conversion or sanctity. The fish alludes to the water of Baptism which finds meaning in the artist's illustration – the beginning of a new life: Julien's final metamorphosis is close. These animals were also commonly represented in medieval illuminated manuscripts.

Figure 2.56. *On the left:* Representation of *Ichthys*. On *the right: La Légende* (p. 123), MG-MC.

The Bee (*Tetragonula carbonaria*)

Quoting Isidore of Seville, Clark mentions that bees (***Figure 2.57***) are skilful in the business of producing honey [Clark 2006, 190]. In fact, the medieval meaning of these insects is *good workers* [Clark 2006, 192]. Moreover, bees are referred by their greatest protection to their king [queen] and assume that it is noble to die for him [Clark 2006, 193]. Amadeo de Souza-Cardoso depicted bees on the page where the hermit prophesied to Julien's mother that her son will be a saint. In this context, the representation of bees alludes to the crown of holiness that Julien receives at the end of his life. In fact, during his days of self-imposed penitence after having committed the parricide, Julien started helping people, especially those that wanted to cross a violent river. His good works culminated with the episode where Julien risks his life to help the King of kings – Jesus Christ himself, in the figure of a leper.

Figure 2.57. *On the left: The bees* (Ms. Ashmole 1511, fl. 75v), Bodleian Library Source: Medieval Bestiary Archive, 2011. *On the right: La Légende* (p. 57), MG-MC.

[214] It is the acronym of ΙΧΘΥΣ (=Jesus Christ, son of God, Saviour) [Heinz-Mohr 1995, 281].

Finally, in *La Légende de Saint Julien l'Hospitalier*, Amadeo also represented some head of animals[215] that in connection with medieval codices refer to a demoniac sense.

2.4. Conclusion

From Maria Filomena Molder's work, this study adds new perspectives on Amadeo de Souza--Cardoso's *La Légende de Saint Julien l'Hospitalier*. Firstly, it can be considered an artist's book (*livre d'artiste*) and not merely an illustrated book. This datum is justified not only due to the alchemy established between text and image, but also as result of the unity observed in the entire volume (structure, form and binder), that allows to designate it as an art object.

Among its Parisian contemporaries, *La Légende* is an unusual artist's book. In fact, Amadeo did not conceive a book, as result of mechanical printing techniques, such as lithography or woodcut, but decided to create a manuscript. Furthermore, it remained a single piece. By their turn, other *livres d'artistes* had always a limited number of copies. Other handwritten artists' book occurred after the decade of 1920s but always followed by a process of mechanical printing, aiming to produce several copies.

La Légende was created in the precise same year of the first productions of Russian *avant-garde* books. *A Game in Hell*, illustrated by Natalia Goncharova, and Amadeo's book present affinities. That concern with the drawing, in particular, in the stylisation of the physical forms which, in both cases, as related with a "neo-primitive" aesthetic. However, *La Légende de Saint Julien l'Hospitalier* was created during the summer of 1912, while Goncharova's book was published with many copies only in October of that year. From this detail, it is possible to infer that Souza-Cardoso was not inspired by the Russian vanguardist books.

In Portugal, in the early 20th century, because of the provincialism and Naturalistic artistic taste, the reality of the *avant-garde* artists' books was unknown. In 1912, Amadeo's compatriots in Paris were practicing a timid modernism. Only about ten years later, Almada Negreiros created his first artists' books.

In the terminus of his early career, *La Légende de Saint Julien l'Hospitalier* was definitely Amadeo de Souza-Cardoso's "laboratory" of aesthetic experiences. This manuscript is an example of the importance of traveling in the creative process of the artist. In a certain way, it is possible to assume this book as a sort of "graphic journal" of his trip to Brittany (1912). In fact, Amadeo crosses the illustration of Flaubert's tale with elements inspired, in particular, from his visit to Concarneau (the castle of Keriolet and its tapestries, the port, the *sardinières*) and the castle of Vitré. The many decorative elements that allude to this travel, also express the strong emotions that Brittany caused in the artist. The interest in the popular traditions is also clear in this work (*ex-votos*).

Amadeo was attentive to the artistic productions from the *École de Paris* and was particularly interested, around 1912, in the works of several artists and in the new artistic movements: Cubism and

[215] As previously referred, also at the *Château de Keriolet*, gargoyles have this same meaning.

Futurism, Modigliani and his sculptures inspired in the African tribal masks and in archaic art; the Russian *avant-garde* artists, Henri Rousseau, *Le Douanier*'s "Primitivism" and its exotica and finally, Robert Delaunay and his strong contrast of colours and "simultaneous" dynamism. In *La Légende*, Amadeo de Souza-Cardoso discovered colour and this fact led consequences in his future work.

In another context, according to the influence of the philosopher Henri Bergson in Amadeo's work the concept of "simultaneity" is visible in the multiple "oscillations of identity", related with Julien's metamorphosis. This concept is also connected with the fusion of elements from modern art with elements from medieval art, namely, the works of Flemish "primitives" and the illuminated manuscripts.

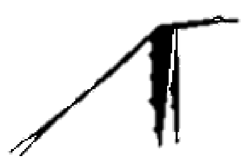
Souza-Cardoso clearly admired the work of the medieval masters. The bridges that he established with their codices is evident in *La Légende de Saint Julien l'Hospitalier*, especially, in the way how the book is structured, in the relation between text and images, in the presence of decorated capital letters, in the division of the chapters with decorated Roman numbers and in the presence of elements such as the end-of-lines. Nevertheless, the dialogue established seems more evident when comparing with medieval Flemish Books of Hours. Such productions used elements from nature for the decoration of the margins, fact that find similarities in *La Légende*.

Amadeo also created his own bestiary which, curiously, finds meeting points with its meaning in the Middle Ages. This fact evinces the knowledge the artist had on the topic. The inspiration in the Books of Hours seems related with the artist's "aristocratic soul" and his interest on heraldry, as well.

In some pages of the manuscript, the text assumes a shape, becoming also an image. This resource was used not only in the medieval manuscripts but also can be found in many contemporary examples.

The piece *La Légende de Saint Julien l'Hospitalier* expresses Amadeo's hard work capacity and dynamic temperament. In the wings of the falcon, he discovered that being *a bit of everything* was clearly his artistic identity. The words that Manuel Laranjeira addressed to Amadeo prophesied the painter's future starting from *La Légende*: *You will win, you will triumph! I am sure*[216]*.*

Accomplir c'est vaincre!



[216] From a letter from Laranjeira to Amadeo (Espinho, October 27, 1906) [apud Laranjeira 1990, 70] (Translation by the author of this dissertation).

❷

MATERIALS AND TECHNIQUES OF *LA LÉGENDE DE SAINT JULIEN L'HOSPITALIER*

It is not possible to make a work of art without a thrill.[217]

Amadeo de Souza-Cardoso, 1910

CHAPTER 3: The art of beauty: the construction and state of conservation of *La Légende*

3.1 Preamble

As a starting point for the discussion of the materiality of Amadeo de Souza-Cardoso's *La Légende de Saint Julien l'Hospitalier* (***Figure 3.1***), the term "artist's book" will be revisited a second time[218]. Researcher Sara Afonso Ferreira offers the following definition of an artist's book:

> *Artist's book, a book that transcends its usual definition ('a number of sheets of paper or parchment, printed or handwritten, sewn together to form a volume') to become a versatile vehicle of artistic expression in which the complete object surpasses the sum of its parts* [Ferreira 2014, 139].

Figure 3.1. Frontispiece of *La Légende*, p.9, MG-MC.

This chapter deals in particular with the issues concerning the creative process of Souza-Cardoso's artist's book. The characterisation made by visual examination methods such as observation by means of optical microscope (OM) [*see **Appendix A3.1***] and transmitted light[219] will be first presented. These techniques were implemented for a deeper understanding about two fundamental elements in this book: the bookbinding and the text block support, and also the global state of conservation of *La Légende de Saint Julien l'Hospitalier*.

Afterwards, the knowledge of the practices of the time for watercolour drawing and painting were evaluated while studying Amadeo's artistic technique in this artwork. The analysis was performed by comparing the results from the visual observation of the manuscript (at the macro and microscopic level) with the artist's drawing technique analysis made by four professional illustrators[220], who collaborated in this investigation by analysing high-resolution photographs taken from the manuscript. Finally, the results gathered with this partial study added to those presented in ***Chapter 4***, which refer to the study of the pictorial materials and techniques used by Amadeo in the creation of *La Légende*, will contribute towards the goal of establishing an adequate conservation strategy for this unique artist's book.

[217]From a letter from Amadeo to his uncle Francisco [apud Alfaro 2007, 122] (Translation by the author of this dissertation).
[218]Cf. *Chapter 2, section 2.2.*
[219]The examination by transmitted light was performed using a light sheet, making light pass through the paper from behind.
[220]Catarina Sobral, Danuta Wojciechowska, Ricardo Alexandre Correia and Isabel Monteiro.

3.2 Structure of *La Légende de Saint Julien l'Hospitalier*[221]

When one opens Amadeo's *La Légende de Saint Julien l'Hospitalier*, probably, what most catches ones attention is the first part of the book: the synopsis[222]. This may happen due to the strong chromatist contrast between gold and black. Although it is evident that the artist has deep knowledge of Gustave Flaubert's tale, expressed in the way he copied and illustrated it, the order of some pages in the synopsis does not correspond to the sequence of the narrative [*see* ***Appendix A1.1***]. In accordance to Flaubert's tale [*see* ***Chapter 2, section 2.1.1***], ***Figure 3.2*** shows that after p. 30, the subsequent pages should be correctly ordered as p.39, p.36, p.33. This fact seems to indicate an error by the artist or binder in the organisation of the pages of the manuscript. Pages 42 and 45 were inserted in the correct position.

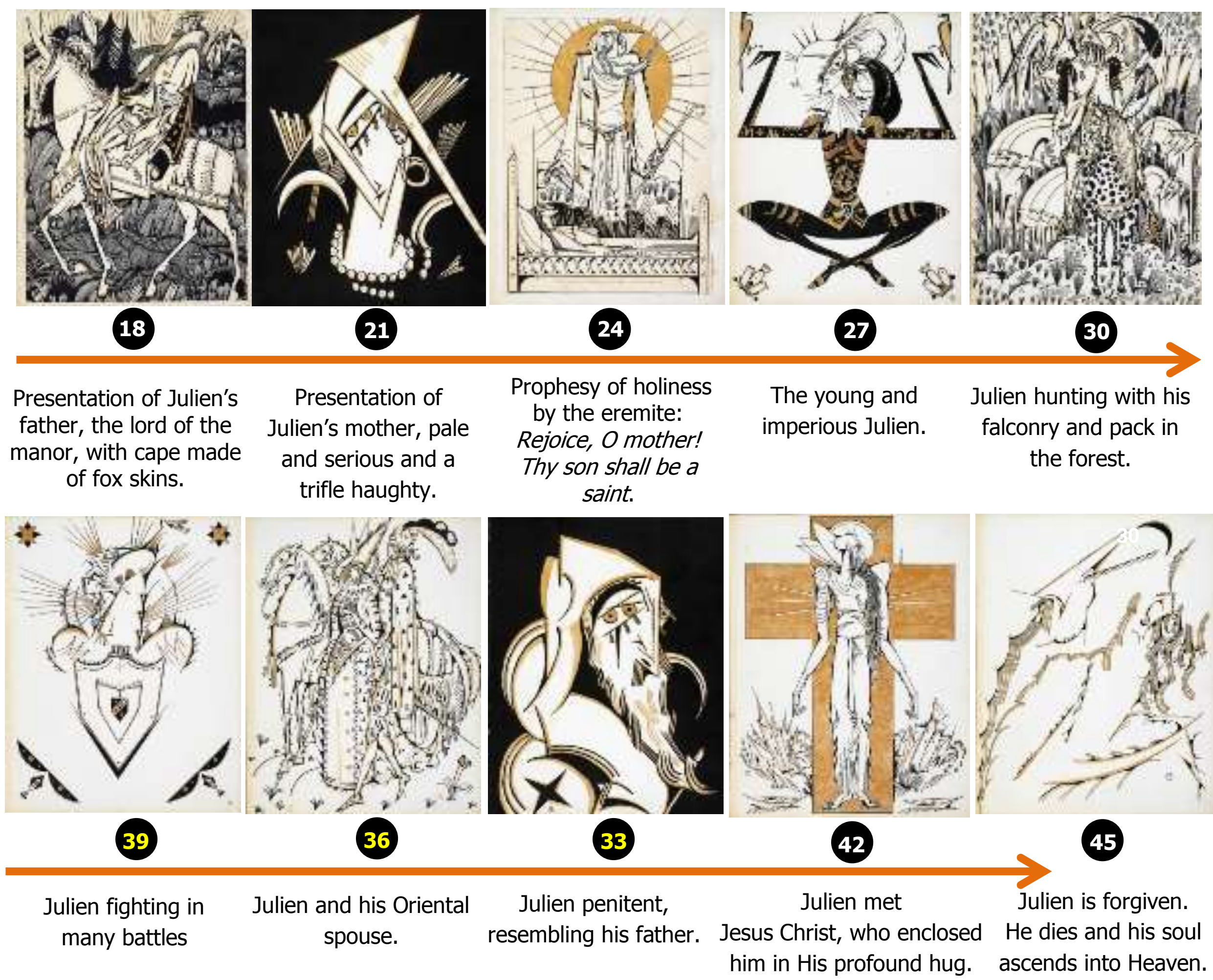


Figure 3.2. Correct sequence the synopsis of *La Légende* should display, MG-MC.

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[221]The meaning of the technical terminology used in this chapter may be found in a glossary in *Appendix A3.2.*

[222]As referred in *Chapter 2*, *section 2.1* is a term firstly applied by Maria Filomena Molder and regards the set of pages between p.17 and 47 of Amadeo's manuscript [Molder 2006, 14].

Another observation is that some drawings were trimmed during the sheet-cutting process (***Figure 3.3***). On top of p. 132, one can observe that the man's head was clearly cut out, as well as the paws of the peacocks bellow, in p. 89.

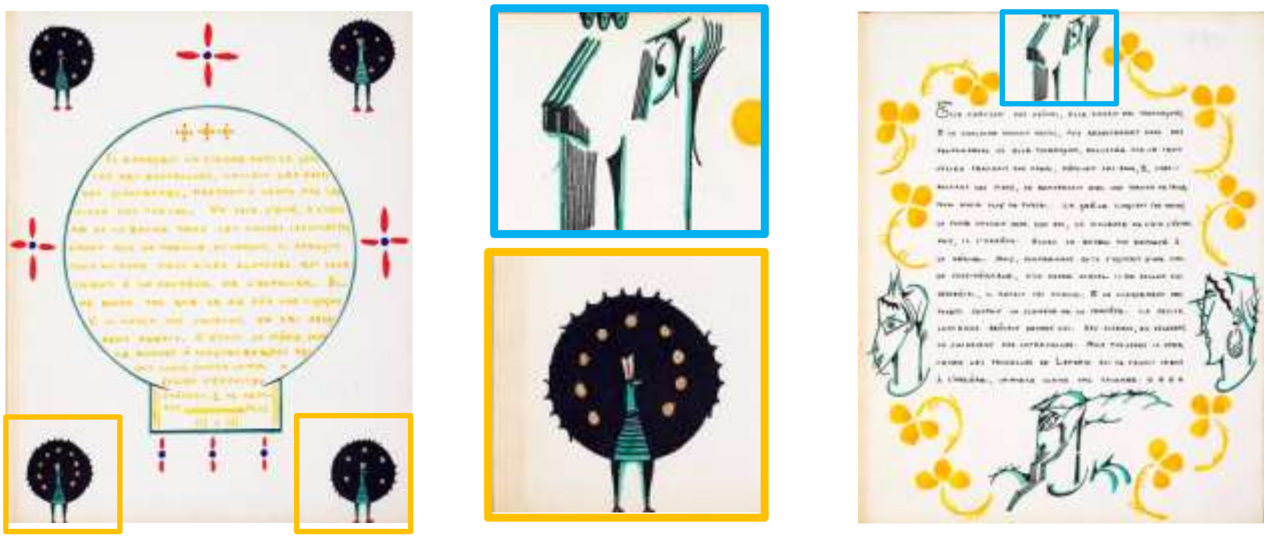

Figure 3.3. Indication of the drawings trimmed in *La Légende*: p.89 and 132, respectively, MG-MC.

It is worth referring that Amadeo did not insert one of the frontispieces he had drawn for the book (***Figure 3.4***). This drawing has the same dimensions of the pages of *La Légende de Saint Julien l'Hospitalier* (268 x 210 mm). As discussed in ***Chapter 2***, ***section 2.2.***, Souza-Cardoso deliberately inserted blank enumerated pages in the structure of the text block. They intend to follow a particular role in Amadeo's artist's book, as already referred in that chapter. These observations seem to propose that the artist bound the book after finishing Flaubert's tale illustration.

In the following section, the structure and condition of the bookbinding and text block of *La Légende de Saint Julien l'Hospitalier* will be discussed.

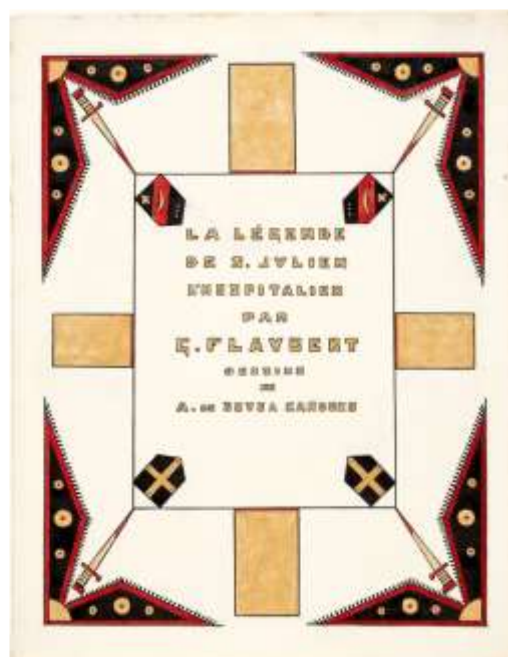

Figure 3.4. Frontispiece (not used) for *La Légende de Saint Julien l'Hospitalier*, 1912 (drawing, Chinese-ink and gouache), MG-MC.

3.2.1 Bookbinding

The outside aspect of a book, i.e. covering materials and decoration, is the first thing that catches the reader's attention and may provide elements to understand and interpret the contents of the book itself [Pearson 2005, 3].

La Légende de Saint Julien l'Hospitalier presents album-type bookbinding (***Figure 3.5***). The whole bookbinding (i.e. covering cardboards and spine) cover material is parchment or limp vellum[223], as will be discussed in ***Chapter 4, section 4.4***. The choice of this material in the artist's book is meaningful. Beyond the many connections with medieval manuscripts identified in ***Chapter 2, section 2.3***, the presence of this material on the cover immediately refers to the medieval ambience of Flaubert's tale.

According to P.J.M. Marks, curator of book bindings at the British Library, parchment or vellum bindings were used in particular on the 16th and 17th centuries. As also mentioned by this author, in the 19th century, vellum enjoyed a revival on books produced by private presses [Marks 1998, 44]. Thus, in 1912, Amadeo chose an unusual material for his time for the cover of *La Légende de Saint Julien l'Hospitalier*.

Figure 3.5. *On top: La Légende*: Upper cover, MG-MC. *Bellow:* Head edge of *La Légende*.

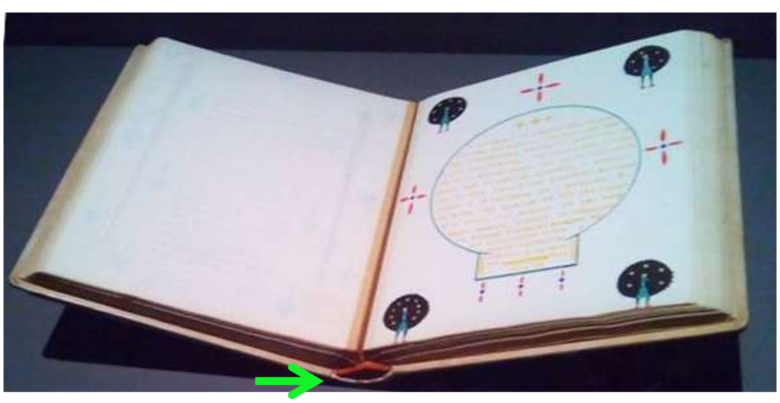

Figure 3.6. *La Légende de Saint Julien l'Hospitalier*: hollow spine round shaped.

The head edge of the manuscript was decorated with brushes of a Bordeaux colour (***Figure 3.5***). The book's spine is hollow spine round shaped (***Figure 3.6***). It was reinforced with paper as lining material.

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[223]Despite the controversy around this term, in this dissertation the meaning of "vellum" deals with the thickness of the material. It stills being considered parchment [Young 1995, 29; Goffer 2006, 332]. Some authors point out that vellum is made from drying calfskin and parchment from sheep or kid [Pearson 2005, 20; Husband 2008, 340].

Regarding the state of conservation, the book's spine presents a fissure in the lower side of the cover, probably due to handling.

The front-cover of *La Légende de Saint Julien l'Hospitalier* is decorated with the remains of three coats of arms (***Figure 3.7***).

Figure 3.7. Detail from the cover of *La Légende* showing the remains of three coats of arms painted.

The illustrated pages of *La Légende* were inserted in thick guards and glued (***Figure 3.8***). They were made in lower quality paper. High levels of deterioration are evidenced by paper brittleness.

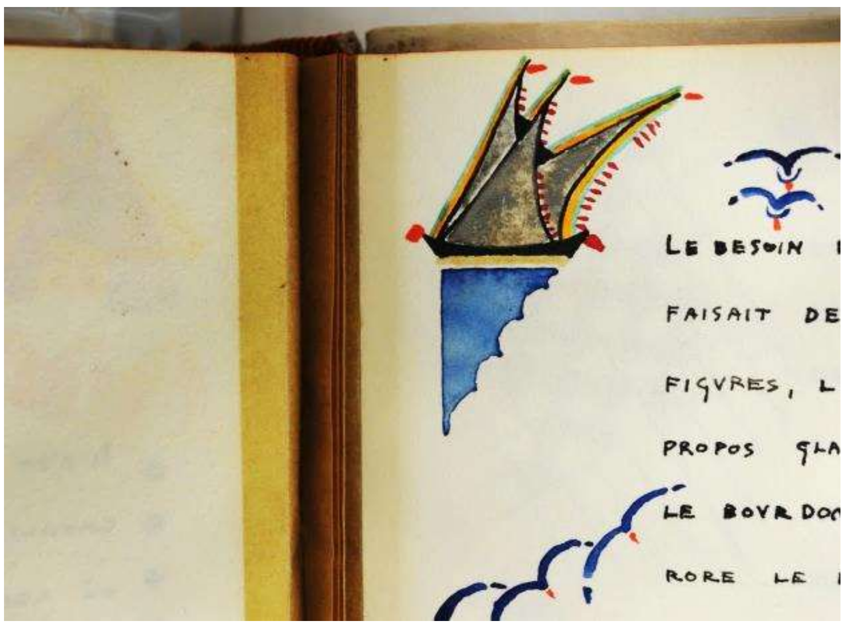


Figure 3.8. Guards between p. 123 and 124 of *La Légende*.

As referred in the ***General Introduction*** of this dissertation, marble-type paper was used on the endpapers. The fly-leaves present darkening due to deterioration [*see* ***Appendix A3.3***]. In some years, the aesthetic qualities of the endpapers may compromise the integrity of the text block[224]. This paper deterioration will be discussed in ***section 3.2.2***. This phenomenon is more evident on the margins by virtue of some factors, such as the contact with light, dust, air and humidity [Dibdin 2013, 110].

[224]Note that the bookbinding, endpapers and fly-leaves are materials from the bookbinder.

3.2.2 Text block

The type of paper used by Amadeo de Souza--Cardoso to illustrate Flaubert's tale is visibly of good quality and in much better condition compared with the endpapers and fly-leaves. However, the paper sheets of the illustration present a slight yellowing. This phenomenon is more evident in the margins of the pages of *La Légende de Saint Julien l'Hospitalier* (***Figure 3.9***), probably due to the same reasons referred for the fly-leaves.

Figure 3.9. Example of yellowing observed in the pages of the text block of *La Légende*, MG-MC.

In the pages where silver painted areas are observable, all those areas present a high grade of oxidation in the margins with different coloration, especially *versus* the head edge, bottom edge and fore--edge, but not so visible in the inner areas (***Figure 3.10***) [*see* ***Appendix A3.3***]. The degradation mechanisms occur due to the contact with factors such as air and humidity [*see* ***Appendix A4.6***].

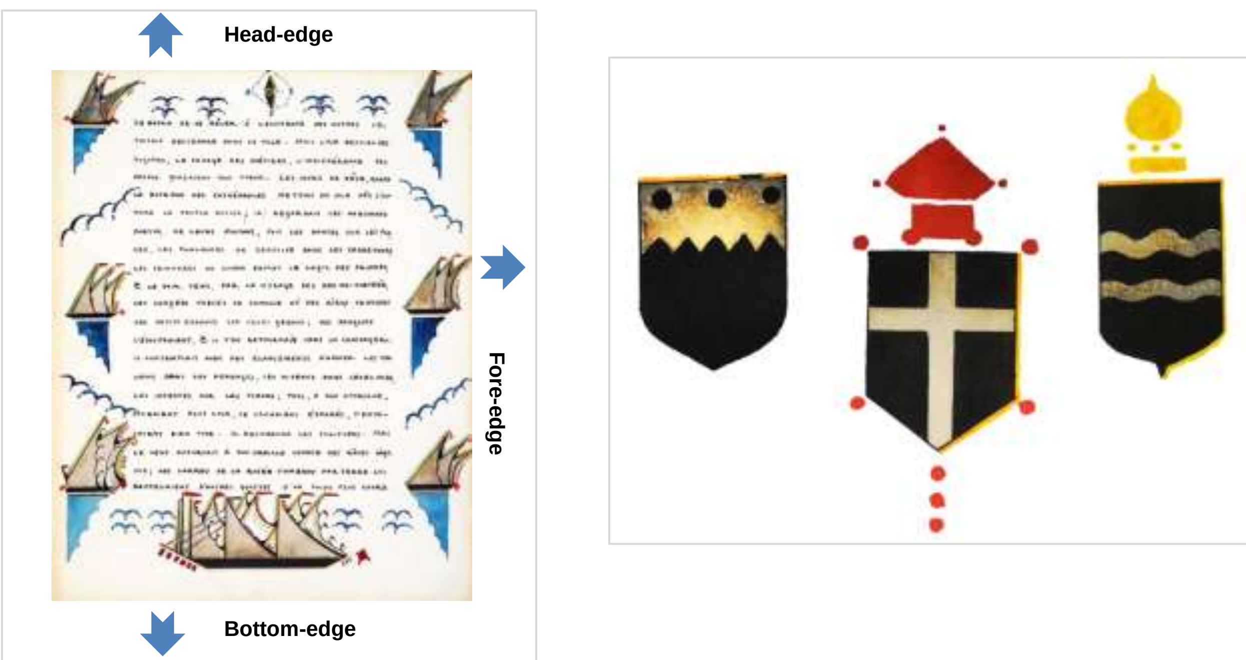


Figure 3.10. Examples of silver oxidation in *La Légende*: *On the left:* p.124, MG-MC. *On the right:* details from p.109, 97 and 108, respectively.

The main source material of all paper is cellulose [Gettens and Stout 1966, 246]. For the conservation of the manuscript, it is necessary to understand the nature of the used paper and in which way it was produced[225]. These topics will be discussed below for *La Légende*'s case.

- **Paper used in the illustration**

In an artist's book, the choice of the paper is an important one and, evidently, one that is determinant for the final presentation of the work [Blundell and Blanckaert 2001, 154]. By means of transmitted light, it was possible to observe that the paper used by Souza-Cardoso in the illustration of Flaubert's tale, bears the watermark: "J. Whatman" – "1912 England" (***Figure 3.11***) – the mark of the manufacturer[226], and the date and place where the paper was produced.

In the artistic milieu, *Whatman* paper was synonymous of premium quality paper since the middle of the 18th century [Hunter 1978, 265; Walsh 2001, 304; Ferraz 2016]. It is known that Amadeo knew quite well the materials he used in his works and chose to buy good quality materials[227]. Art historian Judith Walsh refers why *Whatman* paper was selected for the production of artworks:

> *[Many artists, such as Picasso] chose 'Whatman' paper. Handmade in England from linen rags, 'Whatman' paper was creamy white, sturdy, and perfectly suited to the watercolour technique; an artist could scrub, scrape, or re-wet washes limitlessly on such a sheet. No other paper has ever had quite the same properties* [Walsh 2001, 304].

The paper used by Amadeo, when examined by transmitted light, seems to correspond to a wove paper[228], presenting a uniform surface without laid lines[229] (***Figure 3.11***).

Figure 3.11. Watermarks present in several pages of *La Légende*.

[225]Cf. Strlič *et al.* 2005, 3.
[226]*Whatman* paper mill ('Turkey mill') was established by James Whatman (1702-1759) in 1731 in Maidstone, Kent, England [Hunter 1978, 265; Berger 2016, 281].
[227]Vilarigues *et al.* 2008, 81.
[228]As referred by Joe Nickell, *Early machine-made paper necessarily lacked any watermark, but in 1825 a patented roller, later called a dandy roll, began to be used to impress a watermark* [Nickell 2015, 116]. Erin Blake, head of the Folger Shakespeare Library, pointed out that *wove paper was particularly appreciated by artists and print makers because there was nothing to interfere with the design lines of the art (except for the watermark, if any). Wove paper also stood out as distinctly modern*. In the mentioned text, Blake shows an example of a facsimile of a Shakespeare's item, dated 1807, where the makers deliberately printed it on wove paper watermarked "Shakespeare" and "J. Whatman 1806" (and 1807) [Cf. http://collation.folger.edu/2012/06/learning-to-read-old-paper/ Last accessed on February 11, 2017].
[229]Cf. Nickell 2015, 138 and Berger 2016, 139. According to Walsh, *mold-machine production was introduced to Whatman in the 1930s and hand-paper making finally ceased in 1957* [Walsh 2001, 309].

Cellulose is the major structural component of paper [Strlič *et al.* 2005, 7]. From a microscopic point of view, the analysis by OM (***Figures 3.12 and 3.13***) reveals a mixture of fibres of cellulose derived from cotton and linen[230] in the paper used by Amadeo de Souza-Cardoso, a fact that corroborates with what was previously referred about *Whatman* paper. The high content of cotton in paper ensures its high quality [Szczepanowska 2013, 115].

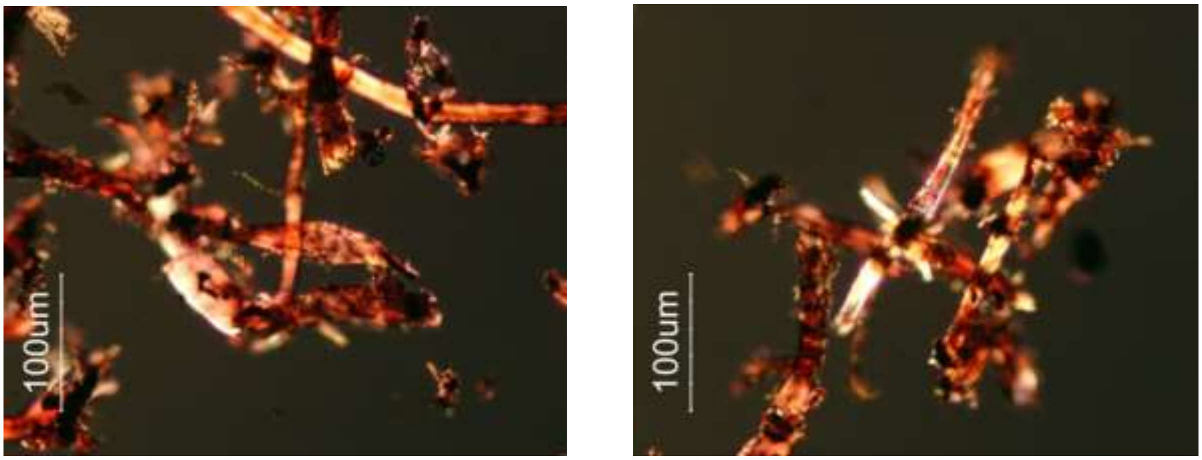


Figure 3.12. Cotton and linen fibres dyed reddish-brown with Herzberg colorant observed by OM from *Whatman* paper used by Amadeo in *La Légende*.

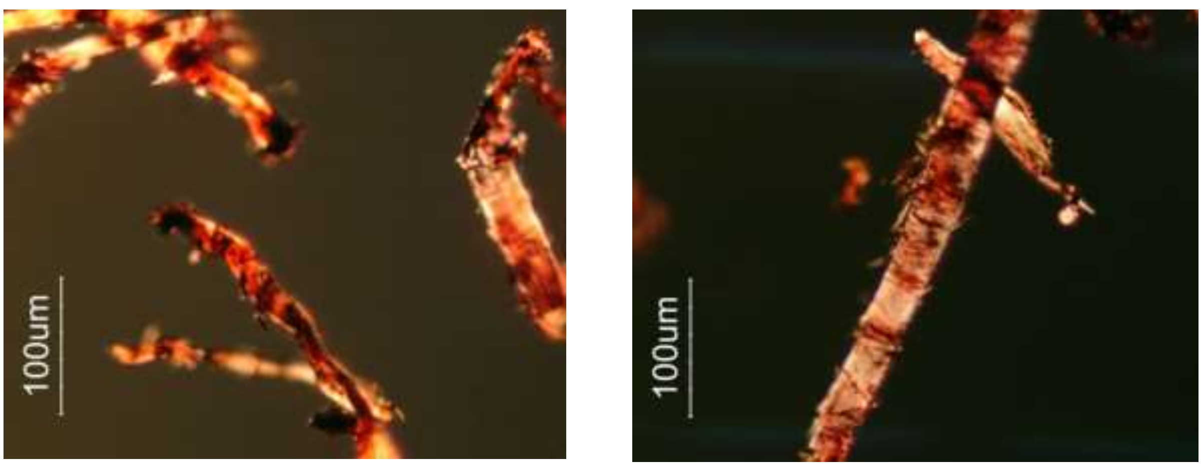


Figure 3.13. Observations by OM of fibres from *Whatman* paper from *La Légende*: *On the left:* cotton fibres. *On the right:* linen fibres.

- **Paste-downs, fly-leaves and guards**

The marbled-type paper used in *La Légende* in the past-downs presents in the recto the same nature of the paper as the fly-leaves. Looking at the past-down from the front, one might conclude its production underwent a machine-made process, since the surface presents a homogeneous pulp and bright decoration [*see* ***Appendix A3.3***].

[230] Cf. The presence of fibres with nodules denote linen [Szczepanowska 2013, 114]. Cotton fibres are long and show twist and ribbon--like shape [*Idem*, 115].

In the case of the fly-leaves, the observations by transmitted light also show a paper of homogeneous pulp, originated from machine-made production. Observations of the fibres from the fly-leaves by OM show fibres of wood pulp, from conifers trees[231]. Lignin[232] is present in this paper. Its presence was identified by the micro chemical test of reaction with phloroglucinol[233] [*see* ***Appendix A3.4***]. Paper durability is influenced by lignin but also by other endogenous factors like acidity, metal ions and degradation products. Exogenous factors like heat, humidity, oxygen, light and pollution (dust) may also accelerate the ageing mechanism [Strlič *et al.* 2005, 6].

Figure 3.14. Fibres of wood dyed reddish-brown with Herzberg colorant observed by MO from the paper of fly-leaves.

Regarding the paper of the guards, observations by transmitted light also showed a homogeneous pulp. This seems to be originating also from mechanical production.

The observations by OM revealed the presence of wood fibres (cellulose from conifers trees) (***Figure 3.15***). Lignin was also identified – its presence develops mechanisms of degradation, as previously referred in the analysis of the paper from the fly-leaves. In the case of the guards, they are already in an advanced stage of deterioration [*see* ***Appendix A3.3***]. The other consequences of the degradation process are the occurrence of chain scission and weakling of cellulose fibres with successive deterioration in the integrity of the paper[234] [*see* ***Appendix A3.3***]. One may observe that the area of contact between the guards on the *Whatman* paper of the illustration shows some yellowing, probably, as result of the degradation of the guards [*see* ***Appendix A3.3***].

Figure 3.15. Wood fibres dyed reddish-brown with Herzberg colorant observed by OM from the guards.

[231]Conifer fibres are long, strong and recognisable under microscope by the perforations in their walls [Florian *et al.* 1990, 16; 214 Asunción 2003, 106].
[232]Lignin is a polymer that acts as a natural binder and support for cellulose fibres of woody plants [Florian *et al.* 1990, 23; 215 Asunción 2003, 103; Szczepanowska 2013, 113].
[233]Cf. Brauns and Brauns 2013, 482.
[234]Cf. Rychlý and Strlič 2005, 9.

- **Bookmarker**

A thin tricoloured (green, red and yellow) bookmarker in cotton[235] was found between the guards (***Figure 3.16***).

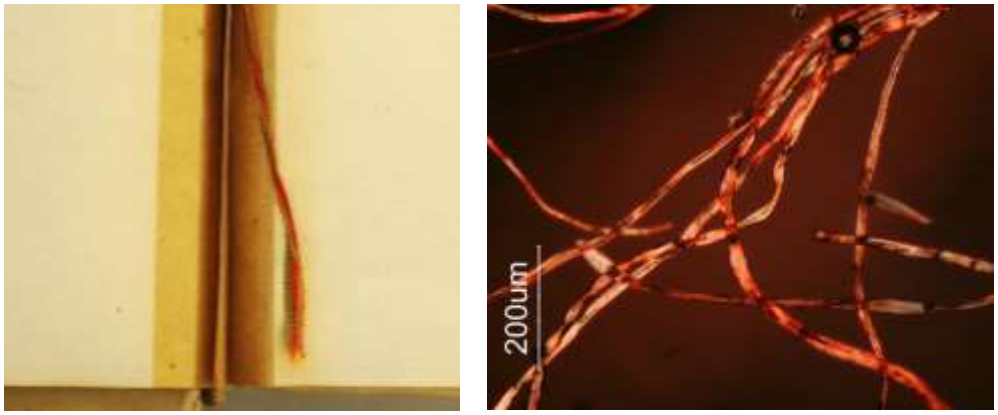


Figure 3.16. *On the left:* Bookmarker present in *La Légende*. *On the right:* Fibres of cotton dyed reddish-brown with Herzberg colorant observed by MO from the bookmarker.

3.3 Amadeo's technique

In the artist's book *La Légende de Saint Julien l'Hospitalier*, the harmonious blend of colours, the lightness and delicacy of forms are the result of Amadeo de Souza-Cardoso's talent with watercolour and drawing techniques. Despite his modernity, Souza-Cardoso was aware of artistic practice theory and balanced it with his own creative freedom, as it will be discussed in this section. As noticed by Manuel de Macedo (1839-1915) in *Manual de Pintura* [Painting Manual], the success of the results of watercolour technique depends upon constant and attentive practice by the artist [Macedo 1898, 28]. Through arduous and patient dedication, Amadeo was able to come to grips on his work, with these techniques, as subsequently he would achieve with oil painting.

Figure 3.17. Sosen (1747-1821), *Deer, Shijo School* [*Drawings from the Old Masters*, 1907, 38].

The watercolour term refers to a colloidal suspension where the pigment is ground in water-soluble gums (Acacia Senegal or Acacia Arabica). The typical watercolour painting is executed with paint thinly laid on paper producing transparencies of colours [Gettens and Stout 1966, 77; Shelley 2000, 21; Cennini 2003, 296]. Its vibrancy results from the transmission of light through the layers of colour and the reflections of the underlying white paper [Shelley 2000, 21; Ferraz 2016].

[235] It presents the typical twisted ribbon aspect characteristic of cotton fibres [Szczepanowska 2013, 115].

Gouache differs from watercolour in opacity. Like watercolour, it is commonly applied on a support of paper, but less thinly. Moreover, white pigments, such as zinc white (ZnO) can be added, promoting its opacity [Catalogue W&N 1896, 1; Gettens and Stout 1966, 29; Ferraz 2016].

As previously referred in ***Chapter 2***, Amadeo's idea to illustrate *La Légende* seems to have been inspired in the production of medieval codices. In far-East, particularly in Japan, watercolour technique was profusely applied [Macedo 1898, 52]. Curiously, Souza-Cardoso was also interested in the latter, since he bought in 1907, the publication *Drawings from the Old Masters* (Second series) (***Figure 3.17***), containing sixty reproductions of drawings by Japanese artists from the British Museum collection (London) at the time[236]. Amadeo de Souza-Cardoso was inspired by this publication, as evident in some works of his early career[237], perhaps in *La Légende*, too.

In the next paragraphs, comprehension of Amadeo's practices in his manuscript will be compared with the principles of watercolour drawing and painting referred by his contemporary, Manuel de Macedo, in his manual. Results discussion will be complemented with observations carried out through transmittance light, by stereo microscope [*see* ***Appendix A3.1***] and also comments by professional illustrators. Since the painter used materials from *Winsor & Newton* (W&N)[238], this analysis will be also enriched with references to the materials catalogue from this brand (1896). This approach will help one imagining Amadeo working on *La Légende*.

❖ **Support**

As previously discussed, Amadeo de Souza--Cardoso used *Whatman* paper for the text block of *La Légende*. Manuel de Macedo cites it as one of the most excellent papers for the practice of watercolour drawing [Macedo 1898, 27]. The artist may have used sheets of Whatman paper from solid blocks (***Figure 3.18***), a practice which was in vogue at the time and was handy for the practice of watercolour drawing[239] during the holidays, as it was Amadeo's case [Macedo 1898, 52; Shelley 2000, 23] .

Figure 3.18. Solid drawing block [Catalogue W&N 1896, 59].

[236]Cf. Alfaro 2007, 121 and *Drawings from the Old Masters*, 1907.
[237]Cf. Freitas 2006, 31.
[238]Cf. Vilarigues *et al*. 2008, 82.
[239]The sheets in the blocks were attached by the top and were separated from the sheet bellow with a knife [Shelley 2000, 23; Ferraz 2016].

❖ Illustrations

As for the illustration of *La Légende*, Amadeo de Souza-Cardoso began sketching out a preliminary drawing with graphite pencil[240], through which he defined the main forms (***Figure 3.19***).

Figure 3.19. Details from the illustration from p. 136, p. 135 and 131, respectively (Magnification: 10x).

According to the illustrators consulted, it became almost certain that in the synopsis, Amadeo delineated those lines with Chinese-ink through a ruling pen or even a nib pen (***Figure 3.20***).

Figure 3.20. *On the left:* Details from the illustration from p. 42 (Magnification: 10x).
On the right: Ruling pens [Catalogue W&N 1896, 138].

[240] This drawing medium became popular since the 19^{th} century with the developing of the pencil industry [Shelley 2000, 17]. References to these pencils can be found as well in Catalogue W&N 1896, 122.

Manuel de Macedo provided a good description concerning the difficulties on the use of ink: […] *the indelible character of the ink does not allow 'pentimenti' or corrections in case of mistake. This fact, forces the artist to an adequate conception and accomplishment of the drawing. The delineation should be done in a definitive and peremptory way; the process does not allow reconsiderations – and, the spontaneous handling requires being a consummate artist*[241] [Macedo 1898, 5].

Amadeo possessed such skills, probably from his previous practice as caricaturist and as student of architecture. The drawing lines and the brush strokes in *La Légende de Saint Julien l'Hospitalier* are precise and the tight contours do not show any sign of hesitation. In the synopsis, the drawing is finished with the application of golden ink brushstrokes made with a thin brush superposed to the previous drawing (***Figures 3.19 and 3.20***). W&N was selling liquid watercolours, at the time. Gold and silver were some of those colours that Souza-Cardoso seems to have used in the illustration of *La Légende* (***Figure 3.21***), fact that will be confirmed in ***Chapter 4***.

The procedure described was implemented in other pages of the illustration, where the same type of lines is visible, even when other colour superposes the black lines (***Figure 3.22***).

Figure 3.21. Gold ink bottle [Catalogue W&N 1896, 36].

Figure 3.22. Details from the illustration from p. 123, p. 135 and 136, respectively (Magnification: 10x).

Some heterogeneity in paint distribution was observed through transmitted light in golden and silver painted areas (***Figure 3.23***). This confirms that Amadeo applied these materials in the form of pigment. Instead of using metal sheet, as observable in medieval illuminated manuscripts[242].

[241]Translation of the excerpt from Portuguese by the author of this dissertation.
[242]Cf. Wieck 1988.

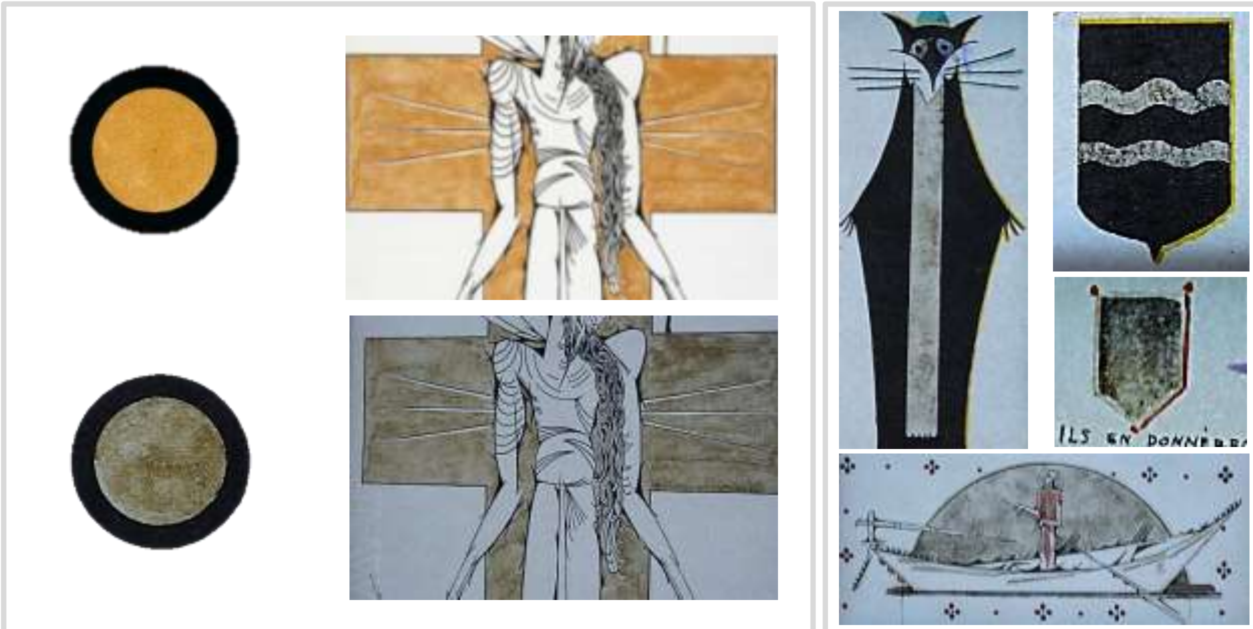


Figure 3.23. Details from golden (*on the left*) and silver painted areas (*on the right*) from *La Légende* (p. 7, 42, 119, 108, 105 and 136) observed by means of transmittance light.

In the case of silver painted areas, as referred in ***section 3.2.1***, these show a certain grade of oxidation. From the observation of these areas through transmitted light, it was possible to see that this phenomenon is more accentuated in areas where there is more saturation of silver paint, especially in the objects drawn in the margins of the pages, which are highly vulnerable due to contact with air and moisture. As already referred, the mechanisms of silver tarnishing will be discussed in ***Chapter 4***.

In the synopsis, already referred, the black background is similar in both p. 21 and 33. In ***Figure 3.24***, it is possible to observe the images through transmitted light, revealing the heterogeneous movement of the brushstrokes in p.33, which would be imperceptible without such resource. Moreover, it allowed the observation of a bellow *pentimento* by the artist in p. 21.

Figure 3.24. *On the left: La Légende* p.33 (*above*) and p.21 (*bellow*), MG-MC. *On the right:* details from the respective page, observed by means of transmittance light.

Another *pentimento* also became visible from the observation of p. 112, where small dots from the preliminary drawing were hidden by the black brushstrokes (***Figure 3.25***).

Figure 3.25. *On the left:* Detail from *La Légende*: p.112, MG-MC.
On the right: details from the same page, observed by means of transmittance light.

In addition, from the examination with transmitted light, it was observed that, in the pages with large dark areas painted with black Chinese-ink[243] (***Figure 3.26***) (such as p. 21 and 33 of *La Légende*), there was "migration" of material to the previous blank page (flip vertical/mirror), where the silhouette in a yellowish colour of the respective drawing is perceivable (***Figure 3.27***). The cause of this datum has not been yet determined. Nevertheless, as noted by Manuel de Macedo, in watercolour, varnish is not applied. Due to the porosity of paper and the repetition of brushstrokes, the dark painted areas (as the case of the Chinese-ink's) present a "blurry" colouration. In order to accentuate such colours, water colour melgip and ox gall[244] would be some of the materials used over the painting or drawing[245] [O'Neill 1861, 70; Macedo 1898, 52]. Their application imitated the effects of varnish in oil paint [Shelley 2000, 27; Ferraz 2016]. This could explain the observed "migration" from the contact between the two pages.

Figure 3.26. Chinese-ink (or Indian-ink) bottle [Catalogue W&N 1896, 36].

[243]It is also known as Indian-ink [Cf. http://www.winsornewton.com/uk/discover/articles-and-inspiration/spotlight-on-indian-ink Last accessed on February 11, 2017].

[244]Shelley refers that *watercolour megilp, a gelatinous substance composed of gum tragacanth, was used to thicken his dark colours without altering their transparency or imparting a luster* [Shelley 2000, 27]. Ox gall is from animal origin. According to a medicine book from 1909: *Ox gall contains "bile-acids" and "bilepigments". The former are present as sodium salts of glycocholic and taurocholic acids. The bile-pigments present are bilirubin, biliyiridin, etc. The remainder consists of cholesterol, lecithin, urea and fat* [Barclay *et al.* 1909].
Ox gall applied for watercolour purposes, is referred in Catalogue W&N 1896, 36. Its role was the same of watercolour megilp. It was also used as a wetting agent to improve flow and drying when mixed directly with watercolours
[Cf. http://www.winsornewton.com/uk; Last accessed on February 11, 2017].

[245]These materials were applied by artists over the very dark painted areas scouring with velvet [Macedo 1898, 52].

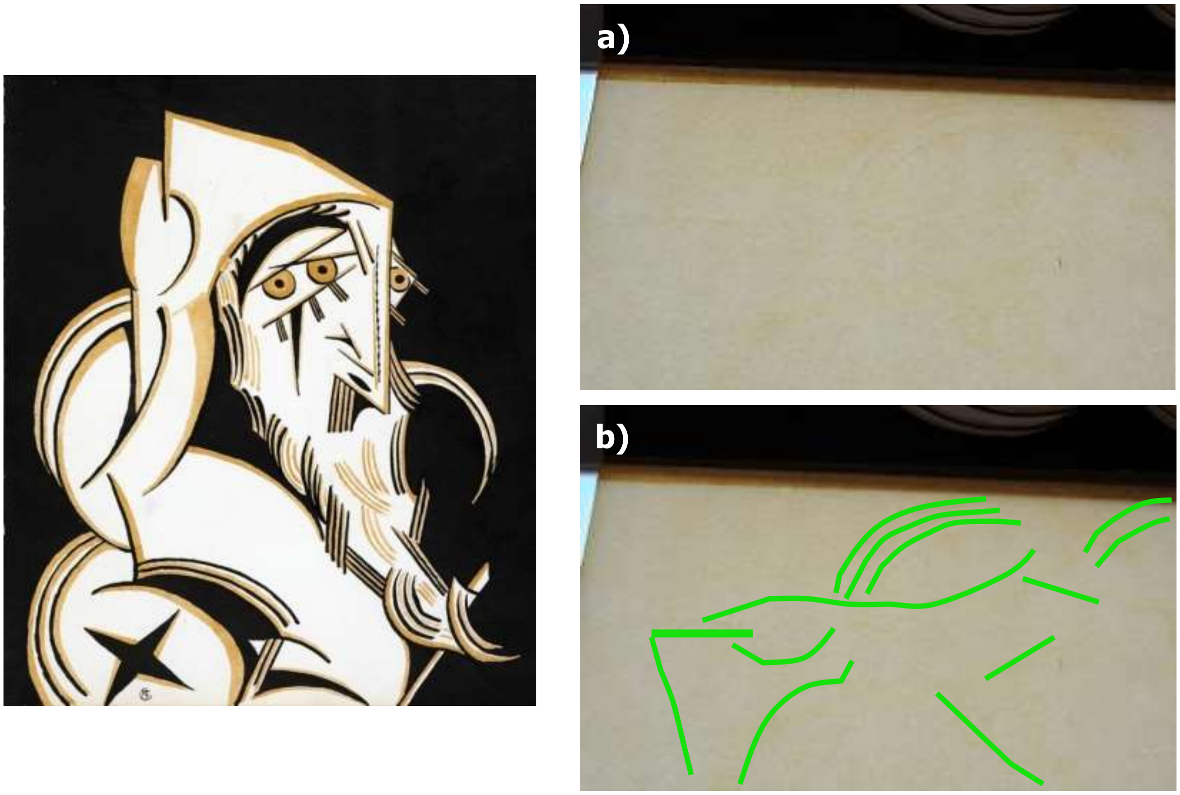


Figure 3.27. *On the left: La Légende* p.33, MG-MC. *On the right:* "Migration" material observed in the reverse side of p.32 from p.33: a) original observation; b) representation of the main lines of the mirrored silhouette observed.

As referred by Manuel de Macedo, the practice of watercolour drawing and painting requires that *the work with brush should be done with quick and swift movements but without precipitation. It is necessary to calculate previously, the limits of the surface that needs to be fulfilled*[246] [Macedo 1898, 28]. Amadeo de Souza-Cardoso paid attention to these issues of this painting technique as it will be better discussed in the following section, concerning handwritten text. His ability with this technique is also visible in some decorative elements of *La Légende* (for instance, flowers, snakes, seagulls), where the painter did not need any preliminary pencil drawing and painted directly with brush upon the paper (***Figure 3.28***).

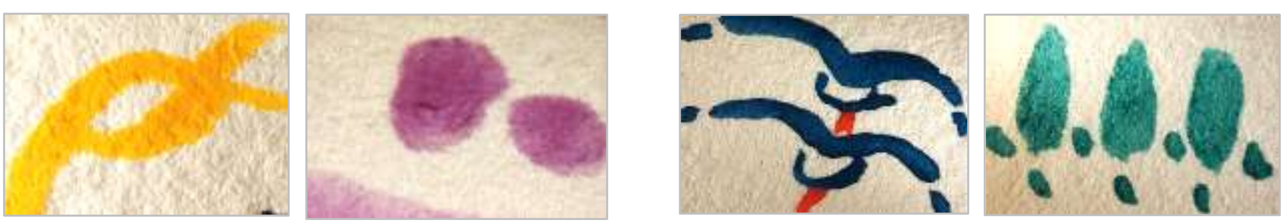


Figure 3.28. Details from the illustration: *On top:* from p. 131 and 105, respectively.
Bellow: from p. 134 and 124, respectively.

[246]Translation of the excerpt from Portuguese by the author of this dissertation.

Macedo mentioned that a watercolour drawing is build little by little and the full intensity of the colours is applied only on the last brushstrokes. Some effects such as the scumble and the *dégradé* are obtained through the use of double-ended brush, where the opposite end of the brush will be always wet for the task (***Figure 3.29***) [Macedo 1898, 28].

Figure 3.29. *On the left:* Detail from *La Légende* p.128, MG-MC.
On the right: Double-ended camel hair brush for watercolour technique [Catalogue W&N 1896, 46].

In 1912, both watercolour cakes and moist watercolour in tubes, similar to those of oil painting, were already widely available[247]. However, the single evidence that may indicate that the Portuguese artist used moist watercolour in tubes regards the presence of one of these tubes from the British W&N in Amadeo's family estate in Manhufe[248] (***Figure 3.30***). In the artistic milieu, the most used watercolour materials at the time were British, and artists were aware of their higher quality [Macedo 1898, 26]. Moreover, from the observations by stereo microscope, it became clear that Amadeo de Souza-Cardoso applied both body-colour (gouache) and transparent watercolour in this work (***Figure 3.31***). The selection of paper was also crucial for the final effect produced by the colours. In the painted areas superposition of colours is not observable.

Figure 3.30. *On top:* Example of moist watercolour in tube [Catalogue W&N 1896, 26]. *Bellow:* Amadeo's tube from his family's estate in Manhufe. Photo credit: DCR-FCT-UNL.

Figure 3.31. *On the left:* Example of transparent watercolour painted areas from *La Légende* p.123.
On the right: Example of body-colour painted area from *La Légende* p.131, MG-MC.

[247] Cf. Catalogue W&N 1896 and Ferraz 2016.
[248] This information obtained from the team from DCR-FCT-UNL that carried out the first study on Amadeo's materials and techniques for the Catalogue Raisonné (2008) [Cf. Vilarigues *et al.* 2008].

- **Handwritten text**

The paper used by Amadeo for the drawings in pages 18 and 24 [*see* ***Appendix A1.1***], is of lower quality, having been glued later to the *Whatman* paper sheet. From an observation of p. 24 through transmitted light, it became visible that Amadeo painted on a sheet of *Whatman* paper already partially used. In fact, it is clearly observable traces of an excerpt of Flaubert's tale that is, by its turn, present in p. 62 of *La Légende*[249] (***Figure 3.32***).

Figure 3.32. *On the left: La Légende*: p.24, MG-MC. *On the right:* front and back of the same page, where is observable the hidden text by means of transmitted light.

LE PÈRE ET LA MÈRE DE JULIEN
HABITAIENT UN CHÂTEAU, AU MILIEU DES BOIS, SUR
LA PENTE D'UNE COLLINE.
LES QUATRE TOURS AUX ANGLES AVAIENT DES TOITS
POINTUS RECOUVERTS D'ÉCAILLES DE PLOMB, ET LA
BASE DES MURS S'APPUYAIT SUR LES QUARTIERS DE
ROCS, QUI DÉVALAIENT ABRUPTEMENT
JUSQU'AU FOND DES DOUVES.
LES PAVÉS DE LA COUR ÉTAIENT NETS
COMME LE DALLAGE D'UNE ÉGLISE. DE LON-
GUES GOUTTIÈRES, FIGURANT DES DRAGONS
LA GUEULE EN BAS, CRACHAIENT L'EAU
DES PLUIES VERS LA CITERNE; ET SUR
LE BORD DES FENÊTRES,
À TOUS LES ÉTAGES, DANS UN POT D'ARGILE PEINTE,
UN BASILIC OU UN HÉLIOTROPE S'ÉPANOUISSAIT.

Figure 3.33. Detail of the text from *La Légende*: p. 51, MG-MC.

From this information, one could say that the *modus operandis* followed by Souza-Cardoso started by copying the tale of Saint Julien, followed by illustration. However, after consulting expert illustrators, it became clear that actually, two different procedures were implemented by the artist in the conception of the manuscript. Initially, Amadeo created the limits of the text box and then he started copying the text. The division of the tale per page was well determined by the artist, as mentioned by Maria Filomena Molder[250]. As showed in the example presented in ***Figure 3.33***, the short line spacing at the bottom of the text box confirms that fact[251].

In few cases, it is possible to notice a certain kind of 'last minute deal' between the available space and the remaining text, which tends to present a few lines without the same delicate filling behaviour which can be found in those ones bounded by guide lines (***Figure 3.34***).

[249] *du bruit. La leçon terninée ils descendaient dans le jardin, où se promenant pas à pas, ils étudiaient les fleurs. Quelquefois on apercevait, cheminant au fond de la vallée, une file de bêtes de somme, conduites par un piéton accouter à l'orientale. Le chatelaine qui l'avait reconnu par un marchand, expediait vers lui un valet.*

[250] Cf. Molder 2006, 17.

[251] Similar examples of text incrusted in a text box can be found in p. 52, 53, 57, 59, 60, 62, 65, 80, 81, 87, 89, 93, 94, 96, 97, 99, 100, 101 and 123 of *La Légende* [*see Appendix A1.1*].

Figure 3.34. Details from p. 87, 81 and 123 of *La Légende*, respectively, MG-MC.

In the second case, the text was written first and afterwards, Amadeo carried out the illustration of the page (***Figure 3.35***). In these examples one can observe how the illustration itself was adapted to the text[252].

In what regards to handwriting process, like a medieval copyist monk, Amadeo de Souza--Cardoso began with a slight placement of auxiliary lines drawn with pencil and ruler on the paper sheet (***Figure 3.36***).

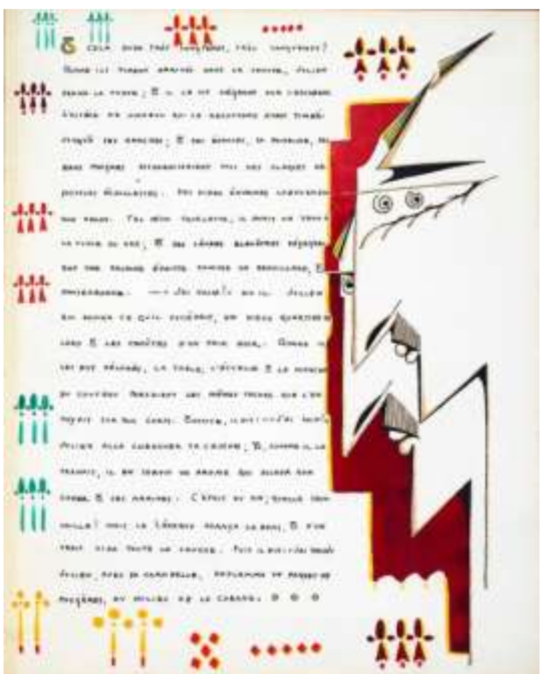


Figure 3.35. *La Légende*: p.134, MG-MC.

Figure 3.36. Examples of the remains of the auxiliary lines drew by Amadeo (black spots) for the handwritting process from p. 89, p. 87 (Magnification: 10x) and p. 100 (Magnification: 40x), respectively.

[252]More examples can be found in p. 55, 56, 63, 66, 67, 69, 70, 71, 73, 74, 76, 77, 82, 84, 85, 88, 103, 104, 105, 107, 108, 109, 111, 112, 113, 115, 116, 117, 119, 124, 125, 127, 128, 129, 131, 132, 135 and 136 of *La Légende* [*see AppendixA1.1*].

In Part 1 of the manuscript, Amadeo de Souza-Cardoso wrote the text mainly using a thin brush and/or a quill pen (or fountain pens) and watercolours. The latter are particularly evident in p. 74 and 80, in the green text, where the colour seems to obey to a cycling movement of the quill writing where the ink initially is more concentrated and gradually fads (***Figure 3.37***). Note that quill pens were widely used since the 6th century until 1820s, having been substituted by metal nib pens [Ward 2008, 481]. The use of this tool by Amadeo may have been inspired by the medieval writing practice with quill pen[253].


SA QVEVE : QVAND IL LEVT TOVT OCCIS, D'AVTRES CHEVREVILS SE PRÉSENTÈRENT, D'AVTRES DAINS, D'AVTRES BLAIREAVX, D'AVTRES PAONS, & DES MERLES, DES GEAIS, DES PVTOIS DES RENARDS, DES HÉRISSONS DES LINX, VNE INFINITÉ DE BÊTES, À CHAQVE PAS PLVS NOMBREVSES. ELLES TOVRNAIENT

Figure 3.37. Section of the text from p. 80 of *La Légende.*

Figure 3.38 Details from the texts from p. 99 and 136, respectively (Magnification: 50x).

In turn, Part 2 was written in Chinese-ink and in a scarlet ink[254], which appears in some pages of Part 1 as well. Part 3 was completely written in Chinese-ink. In the case of Parts 2 and 3, and according to the observations by stereo microscope, the thickness of the letters is thinner than those handwritten in the major part of the pages of Part 1. This fact suggests that in Part 2 and 3, the text has been written with a nib pen. Moreover, through observation of some sections, using a stereo microscope, on the top of the letters (groove), the exerted pressure against the paper by the nib, can also be seen (***Figure 3.38***). Finally, a detachment of the scarlet ink in some letters and the tiny remains spread in the opposite blank page was also observed. Such observations also confirm Amadeo's ability with this practice, since the text does not show signs of hesitation or errors.

3.4. Conclusion

In this chapter, the structure and the state of conservation of the artist's book *La Légende de Saint Julien l'Hospitalier* (1912) were presented and discussed. The bookbinding material of the book is parchment (or vellum). This material was particularly used in the 16th and 17th centuries and in the 19th century. Thus, Amadeo used an unusual cover material in this work. The book's spine is a hollow spine round shaped. Paper was used as lining material.

The bookbinding is an album-type one presenting guards where the pages of the manuscript were inserted and glued, after the completion of the manuscript by the artist. The paste-downs are marble--type paper from machine-made production, as well as the fly-leaves. In the latter but also in the guards,

[253]In a letter to Lucie from 1910, Amadeo wrote: *Some days for me that, to pick a quill is the same of commit a crime* Cf. BA-FCG: 236 ASC 12_09 (Translation by the author of this dissertation), revealing his use of this writing tool. The fact referred is observable in p. 55, 56, 59, 60, 63, 65, 66, 67, 70, 71, 73, 74, 77, 78, 80, 81, 82, 84, 85, 87, 88 and 89 of Amadeo's *La Légende*.
[254]The characterization of this ink will be presented in *Chapter 4*.

wood fibres (with lignin) were observed. These elements were provided by the binder. The fly-leaves and the guards show deterioration and darkening. It is more accentuated in the margins, fact that may be influenced by the presence of lignin but also by other endogenous factors like acidity, metal ions and degradation products. Moreover, exogenous factors like heat, humidity, oxygen, light and pollution (dust) may contribute to the ageing mechanism. Regarding the text block, Amadeo used *Whatman* paper as support for the copy and illustration of the tale. Some of the sheets present the watermark: "J. Whatman" – "1912 England". This is a good quality paper, especially due to the presence of high amounts of cotton fibres, mixed with linen fibres. This paper also presents a slight yellowing, in particular in the margins, also due to contact with factors such as air, humidity and light. In the cases where silver painted areas are present, a high degree of oxidation with different coloration is observed. A tiny bookmarker in cotton is also present in the book.

During the creation of *La Légende* the artist used as support sheets of *Whatman* paper probably from solid drawing blocks. The technique followed by the artist in the tale's illustration was simple. In the synopsis and in similar elements along the manuscript, Amadeo initiated the process by drafting the main drawings with graphite pencil and, afterwards, delineating those lines with Chinese-ink through a ruling pen or a nib pen. Afterwards, the lines were also drawn with golden ink with a tiny brush. The same procedure was observed in other illustrations, where black lines were followed by the superposition of another colour. All the lines and the way the colour was applied shows great ability in both drawing and watercolour techniques, without any sign of hesitation. Other kind of superpositions of colours was not observable.

Transmitted light allowed the observation of some *pentimenti* in some dark painted areas. In those areas, Amadeo applied a material to accentuate the black colouration. It was observed the "migration" of that material to the previous blank page. In the illustration of *La Légende de Saint Julien l'Hospitalier*, the artist used both transparent watercolour and body-colour (or gouache).

Finally, regarding the handwritten text, Amadeo followed two different procedures. In one case he planned the design of the page and built text boxes were text was subsequently written. In the other case, he wrote the text and filled around it with decorative elements. During the writing process, Amadeo did not show signs of hesitation or errors. However, in some cases, it is possible to notice a certain kind of 'last minute deal' between the available space and the remaining text. He drew with graphite pencil auxiliary lines and then started copying the text. In Part 1, Amadeo seems to have used mainly a tiny brush and/or quill pen, due to major thickness of the letters in comparison with Parts 2 and 3, where the artist clearly used nib pen. Through stereo microscope's observation, grooves on top of those letters were found, probably due to the exerted nib's pressure against the paper.

Colour, like music, takes a shortcut to our senses and our emotions.

Philip Ball from *Bright earth* (2012)

CHAPTER 4: Beyond what the eyes see: pictorial materials and technique of *La Légende*

4.1. Preamble

In the Conservation field, the identification of the pictorial palette used in an artwork is crucial for a complete understanding of the object's history and the artist's technique. It may also provide information for dating or attribution of an artwork or artefacts. Finally, the knowledge of the artist's original materials is important for the choice of the better strategies for conservation [Van der Snick *et al* 2011; Mas *et al.* 2014; Vitorino *et al.* 2015].

In the context of paper conservation, the analysis of materials is often very difficult due to the fact that in such delicate art pieces paint layers are usually very thin and small in area. In these situations, micro-sampling is very difficult or not possible [Montagner *et al.* 2011; Duran *et al.* 2011; Ricciardi *et al.* 2012]. The use of *in situ* techniques is recommended as the most appropriate analytical tool for such cases [Picollo *et al.* 2011; Montagner *et al.* 2011; Ricciardi *et al.* 2012; Miliani *et al*. 2012; Buti *et al.* 2014; Anselmi *et al.* 2015].

Figure 4.1. *La Légende*: p.33 (detail) (Magnification: 10x).

This chapter discloses the main findings from the study of the materials and techniques used in the production of the artist's book *La Légende de Saint Julien l'Hospitalier* (***Figure 4.1***) by Amadeo de Souza-Cardoso. Among the *in situ* techniques, in the characterisation of the pigments present in *La Légende*, UV-Vis-NIR Fibre Optic Reflectance Spectroscopy (FORS) was employed as electronic--vibrational spectroscopic technique; Raman microscopy (μ-Raman) as fingerprinting technique for the characterisation at the molecular level and μ-Energy-Dispersive X-Ray Fluorescence Spectroscopy (μ-EDXRF) was used for the identification of the elemental composition (***Figure 4.2***). Coinciding with the centenary of the manuscript, the analyses were carried out in January 2012 in the framework of the *Crossing Borders* project at the storage of *Museu Gulbenkian*-Modern Collection (MG-MC) where the piece is kept in custody. The obtained results contribute for the determination of Amadeo's pictorial palette at the end of his early career and will be compared with the results published in the second volume of the Catalogue *Raisonné* (2008)[255] and by Cristina Montagner in the study of Amadeo's last oil paintings (c. 1917)[256] in the framework of the *Crossing Borders* project. The most interesting areas to analyse were selected from the observations presented in ***Chapter 3***. This study will also contribute for the discussion of the role of colour in *La Légende* and to the establishment of an adequate preventive conservation plan.

4.2. Pages selected for analysis

For this study, firstly, 37 pages from the 83 illustrated by Amadeo were selected covering all the colours present in the illustration an in the text handwritten. Secondly, other 29 extra pages were analysed only with FORS for confirmation of the results obtained. ***Table 4.1*** indicates the pages of the manuscript that were analysed[257].

Table 4.1. Pages from *La Légende* analysed for the determination of its pictorial palette.

	Pages from the manuscript
Main pages	2, 5, 21, 24, 27, 42, 48, 52, 53, 60, 62, 65, 66, 74, 80, 82, 84, 87, 88, 91, 97, 99, 101, 103, 104, 105, 108, 116, 117, 119, 123, 124, 131, 134, 136, 137, 139.
Extra pages	51, 55, 56, 57, 59, 63, 67, 68, 69, 70, 71, 77, 78, 81, 85, 89, 93, 94, 109, 111, 112, 113, 115, 125, 127, 128, 129, 132, 135.

Details about the experimental conditions followed for each analytical technique can be found in ***Appendix A4.1***. The spectra acquired obtained by FORS were compared with a spectral database created for this study. It can be consulted at http://mowcres.fors.ifac.cnr.it/[258]. By their turn, the spectra collected by μ-EDXRF and μ-Raman were discussed from spectra references from literature. Moreover, ***Appendix A4.2*** shows the areas of the pages referred on ***Table 4.1***, analysed with the three techniques.

Figure 4.2. Analyses on *La Légende*: *From left to right:* FORS, μ-EDXRF and μ-Raman, respectively.

[255]Cf. Vilarigues *et al.* 2008. This study refers to Amadeo's materials and techniques between 1913 and 1916.
[256]Cf. Montagner 2015.
[257]This data was also applied in the colour mapping study of the manuscript [*see Section 4.7*].
[258]The construction of this database will be presented and discussed in *Chapter 6*.

4.3. Amadeo's bright colours

The obtained results from the characterisation of the pictorial palette used by Amadeo de Souza--Cardoso in *La Légende* has revealed that the coloured areas of the manuscript were painted and written with pure colours, without mixtures. Note that almost all FORS spectra present the signal of paper in the NIR region, making difficult the possibility of identification of the binding medium present in the artist's colours in the wavelength range available for analysis i.e. until 2200 nm [*see* ***Appendix A4.3***]. For this reason the spectra presented in this section will be limited to the range 350-950 nm. Moreover, analyses with μ-EDXRF show in the major part of the cases the elements potassium, calcium and sometimes iron, copper, zinc and lead which are also associated to the influence paper[259] signal as result of the transparency of the paint layers. In fact, when the paint layer is denser, these elements are not detected by μ-EDXRF [*see* ***Appendix A4.3***].

In the following section, the spectra presented summarise the obtained results. Further information can be consulted in ***Appendix A4.4***.

4.3.1 Colourants of the illustration

- ***Violet coloured areas***

Cobalt violet is the most probable pigment present in the violet coloured areas. The FORS spectra acquired in this case present characteristic absorption bands of this pigment at ca. 526 and 580 nm (***Figure 4.3***). These bands occur due to the *d-d* transitions in cobalt ion [Bacci 2000, 342]. Two of the most frequently mentioned of these pigments are cobalt phosphate [$Co_3(PO_4)_2$] or cobalt arsenate [$Co_3(AsO_4)_2$] or a mixture of both types [Carlyle 2001, 503; Corbeil *et al.* 2002; Anselmi *et al.* 2016].

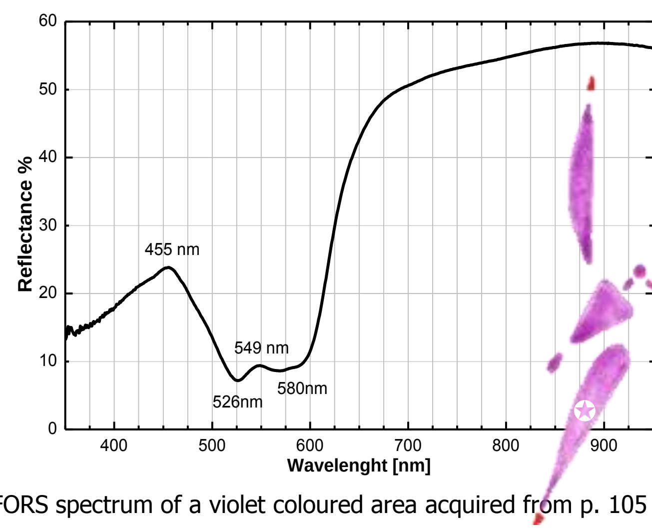


Figure 4.3. FORS spectrum of a violet coloured area acquired from p. 105 of *La Légende*.

[259]The referred elements are intrinsic to paper's manufacture [Cf. Manso and Carvalho 2009; Bronzato *et al.* 2013 and Adami *et al.* 2016].

The elements cobalt and arsenic were determined with μ-EDXRF. This fact can be ascribed to the presence of the second type, cobalt arsenate [Howard *et al.* 2012]. This result is confirmed with Raman microscopy since the spectra obtained present a band located at ca. 884 cm^{-1}, assigned to a symmetric AsO–stretching vibration, characteristic of an arsenate based cobalt violet pigment [Martens *et al.* 2003; Casadio *et al.* 2012](***Figure 4.4***).

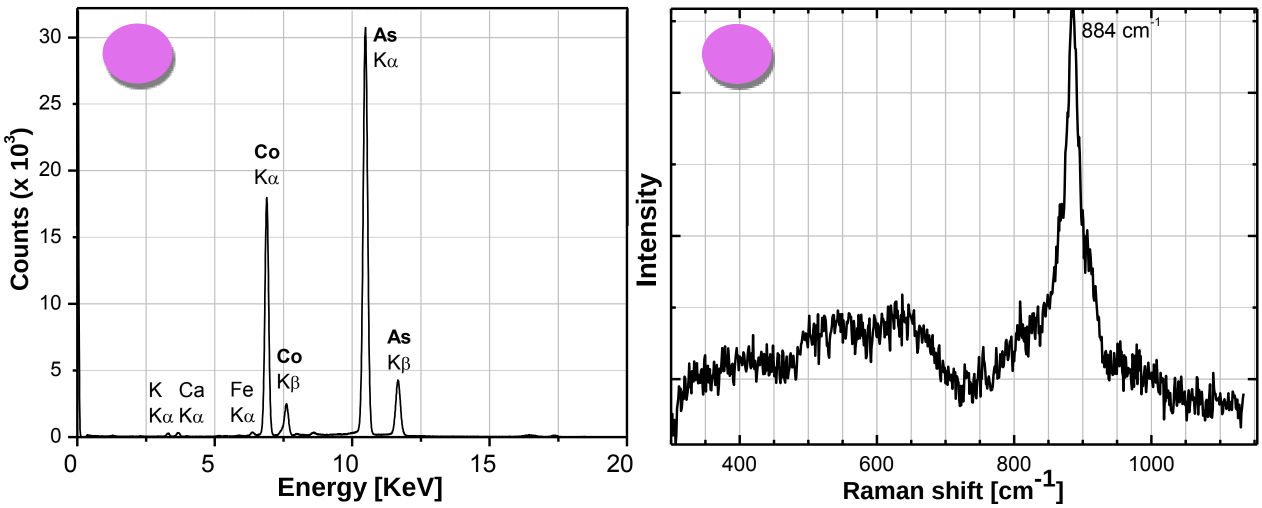


Figure 4.4. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra of a cobalt violet coloured area acquired from p. 105 of *La Légende*.

- ***Blue coloured areas***

In the illustrated areas of *La Légende* two different blues were found. In the dark blue painted areas analysed, FORS identified Prussian blue, an iron (III) hexacyanoferrate (II) ($Fe_4[Fe(CN)_6]_3{\cdot}14H_2O$ or $KFe[Fe(CN)_6]{\cdot}H_2O$]) [Berrie 1997, 191; Ware 1999, 137]. The respective spectra present peak of reflectance at ca. 470 nm and a strong absorption band in the Vis-NIR regions between ca. 600 – 1000 nm, centred at ca. 700 nm, due to a homonuclear intervalence charge transfer transition between the ions Fe (II) and Fe (III) [Bacci 2000, 342; Bacci *et al.* 2009] (***Figure 4.5***). This intense absorption in the range of the yellow, explains

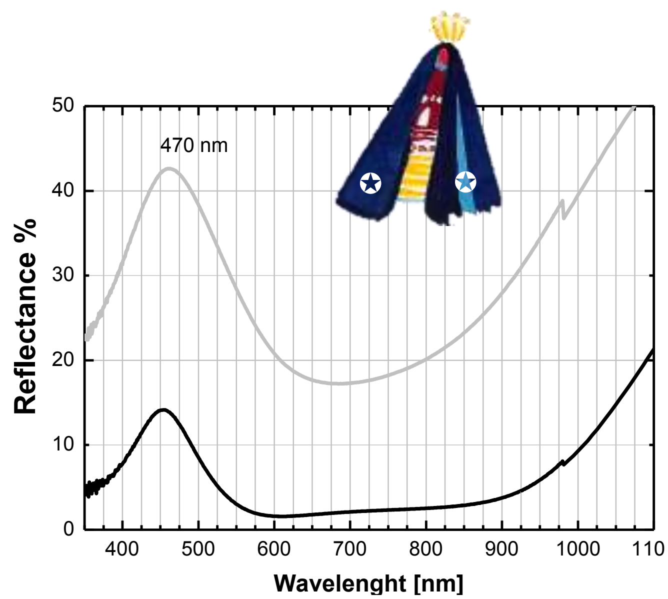


Figure 4.5. FORS spectra of the blue coloured areas acquired from p. 123 of *La Légende* (Note: the grey line refers to the light blue area).

the blue colour obtained [Delamare 2007, 183]. The characteristic features of this pigment in the NIR region are masked by the bands of paper [*see* ***Appendix A4.3***].

As already referred, iron is present in the paper used by the artist. It was nevertheless expected that the large amount of Fe detected through XRF measurements were mainly due to the presence of Prussian blue in these bluish analysed areas [Calza *et al.* 2010]. The Raman spectra collected show the presence of bands at ca. 528, 2089 and 2152 cm^{-1} which confirm the identification of this pigment (***Figure 4.6***). The highest peak values are assigned to the C≡N stretching modes in the hexacyanoferrate ion $[Fe(CN)_6^{4-}]$. The peak at ca. 528 cm^{-1} can be related with an iron cyanide bending mode [Farah *et al.* 2012; Samain *et al.* 2013].

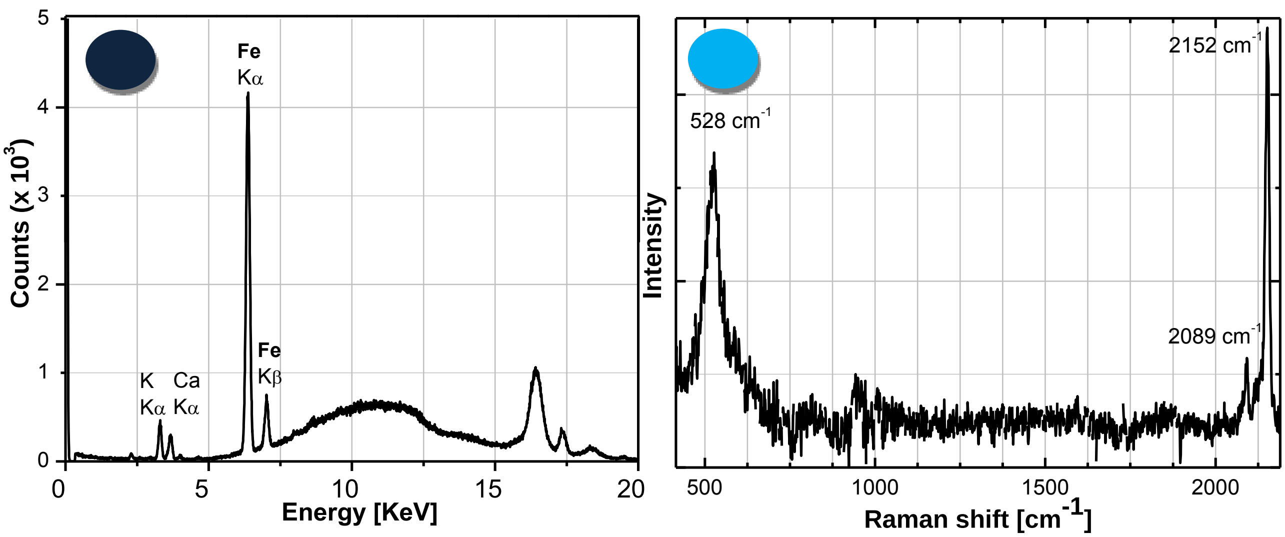


Figure 4.6. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra of Prussian blue coloured area acquired from p. 123 of *La Légende*.

Regarding the composition of the lighter blue, FORS identified it as ultramarine blue (complex sulphur in a sodium aluminosilicate matrix, $Na_{8-10}[Al_6Si_6O_{24}]S_{2-4}$) [Plesters 1993, 55]. The spectra obtained with FORS present a peak of reflectance at ca. 445 nm and a strong absorption band centred at 600 nm, due to the charge transfer transition between S_2^- and S_3^- that occurs in the lattice of the complex aluminosilicate (***Figure 4.7***). According to literature, this pigment does not present any characteristic absorption bands in the

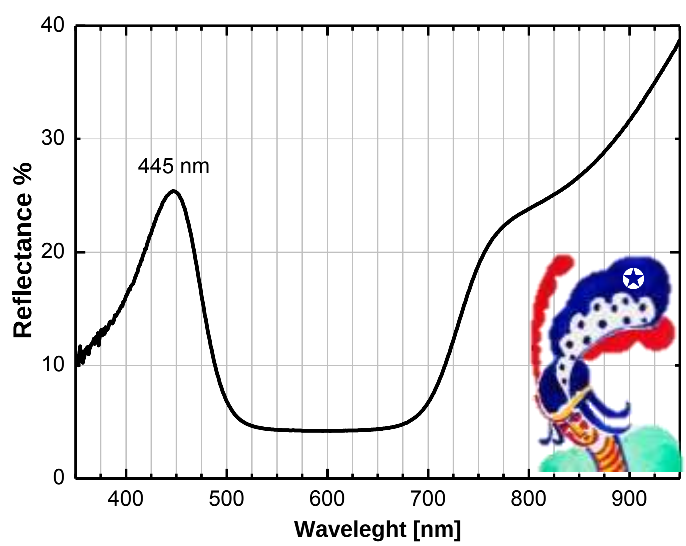


Figure 4.7. FORS spectrum of a blue coloured area acquired from p. 99 of *La Légende*.

NIR range [Bacci 2000, 342; Bacci *et al.* 2009; Aceto *et al.* 2013]. Moreover, the flatter shape of the absorption band referred, starts rising at longer wavelengths indicating the presence of a synthetic version of ultramarine blue [Aceto *et al.* 2013]. With μ-EDXRF, the elements silicon, sulphur and impurities of aluminium and titanium were also detected. They are commonly found in ultramarine blue pigment [Berrie *et al.* 2014, 407]. Finally, μ-Raman presented the distinctive peaks of this pigment at ca. 546, 579, 808, 1096 cm^{-1} [Correia *et al.* 2007; Marcelino and Muralha 2012] (***Figure 4.8***). The strongest peak occurs due to a symmetric stretching vibration of S_3^- and is the primarily responsible for the blue colour of this pigment [Desnica *et al.* 2004]. In addition, the peak at ca. 579 cm^{-1} is attributed to a symmetric stretching mode of S_2^- [Rosi *et al.* 2004].

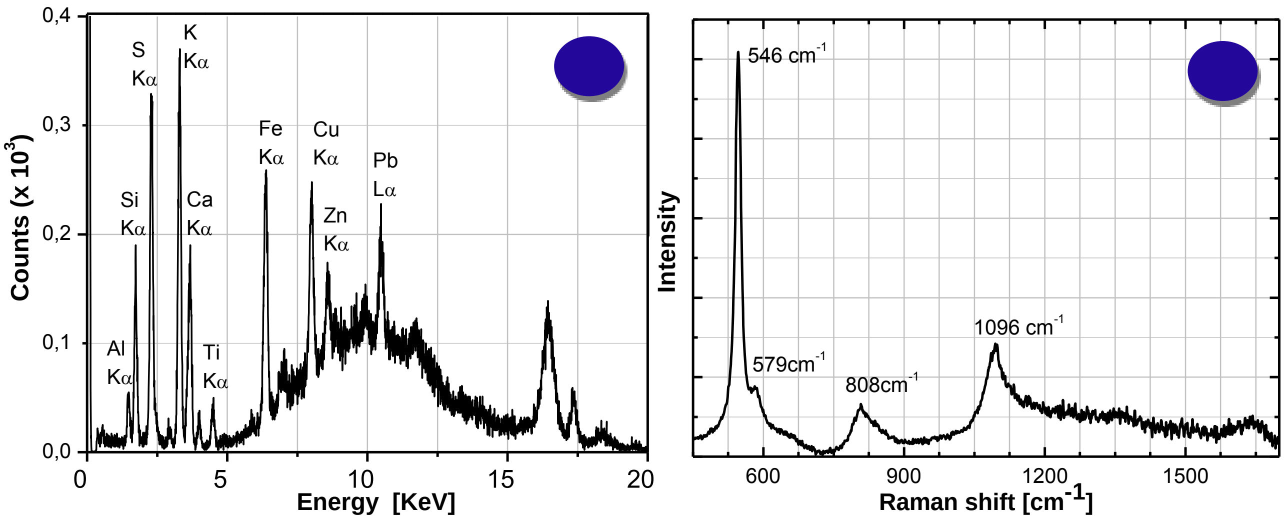


Figure 4.8. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra of Ultramarine blue coloured area acquired from p. 99 of *La Légende*.

- ***Green coloured areas***

In what concerns the green colours present, in the dark green, viridian (chromium (III) oxide dehydrate, $Cr_2O_3{\cdot}2H_2O$) was identified [Eastaugh *et al.* 2008, 397]. This pigment presents a bell shape FORS spectrum with a double absorption, one with a maximum at ca. 428 nm and the other at ca. 625 nm due to *d-d* electronic transition typical of chromium (III) in an octahedral coordination [Bacci 2000, 342; Boselli 2010, 167] (***Figure 4.9***).

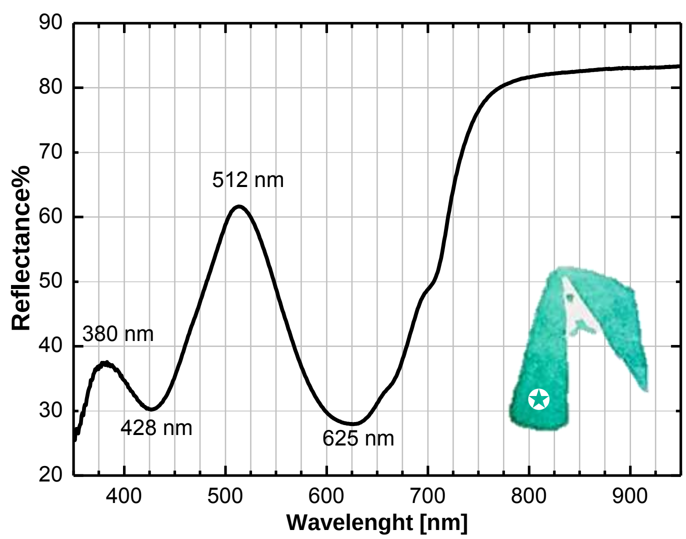


Figure 4.9. FORS spectrum of a green coloured area acquired from p. 123 of *La Légende*.

μ-EDXRF revealed a strong presence of the element chromium in the same areas analysed, as typical for viridian [Rosi *et al.* 2009]. Raman investigations suggest the presence of viridian, presenting spectra with its characteristic peaks at ca. 265 and 486 cm^{-1} [Bell *et al.* 1997, Correia *et al.* 2007] (***Figure 4.10***). Nevertheless, the intensity of these peaks is weak due to high fluorescence background.

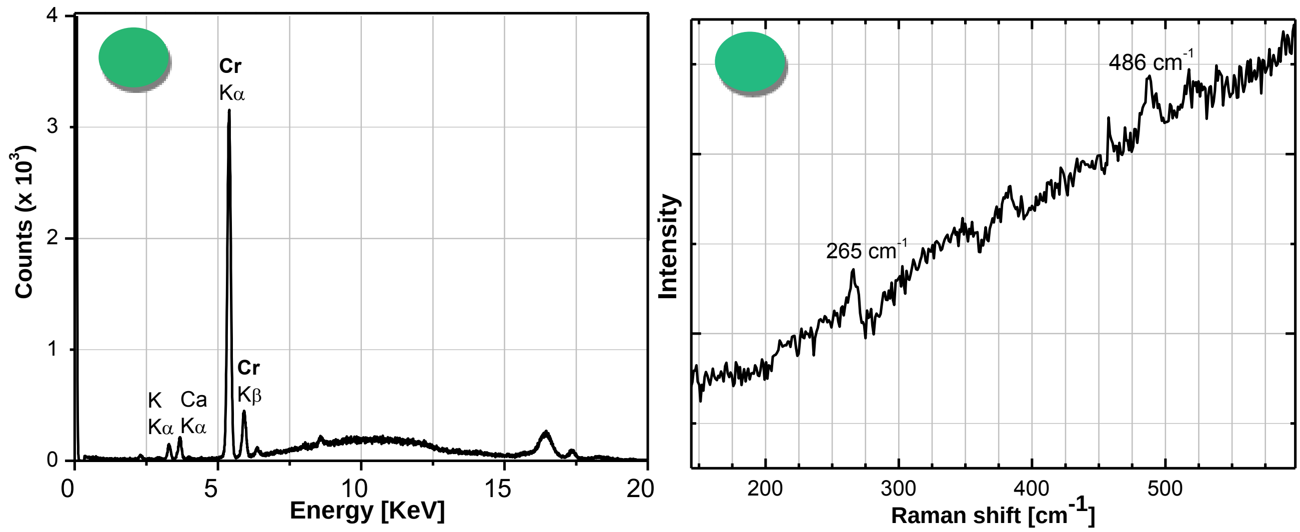
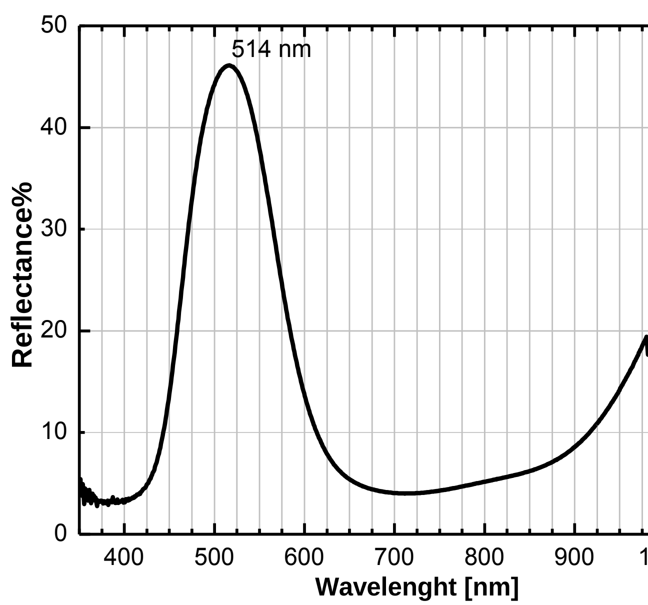


Figure 4.10. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra of viridian coloured area acquired from p. 123 of *La Légende*.

FORS analyses indicate emerald green or Schweinfurt green [copper (II)–acetoarsenate, $Cu(C_2H_3O_2)_2{\cdot}3Cu(AsO_2)_2$] [Field and Bayard 1997, 219] as the probable pigment present in the lighter green areas of the manuscript. The reflectance spectra of this pigment are characterised by a broad absorption from ca. 650 to ca. 1000 nm due to a *d-d* transition in the copper (II) ion. In this case study, the characteristic absorption at ca. 1685 nm linked to the first C-H overtones of the methyl group is not observed due to the strong signal of paper in the NIR region [*see* ***Appendix A4.3***] [Shimoyama *et al.* 1998; Boselli 2010, 148] (***Figure 4.11***).



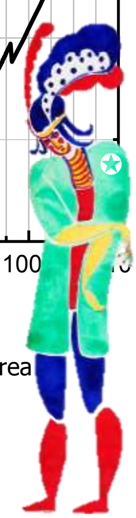


Figure 4.11. FORS spectrum of a green coloured area acquired from p.99 of *La Légende*.

The indication emerald green is corroborated with those of the other techniques: μ-EDXRF measurements revealed a combination of copper and arsenic, usually associated with this pigment [Zieske 1995]. With Raman microscopy, the characteristic bands of emerald green were observed at ca.117, 152, 171, 213, 246, 298, 321, 367, 427, 491, 539, 624, 823, 946 cm^{-1} [Correia *et al.* 2007; Berrie *et al.* 2016] (***Figure 4.12***).

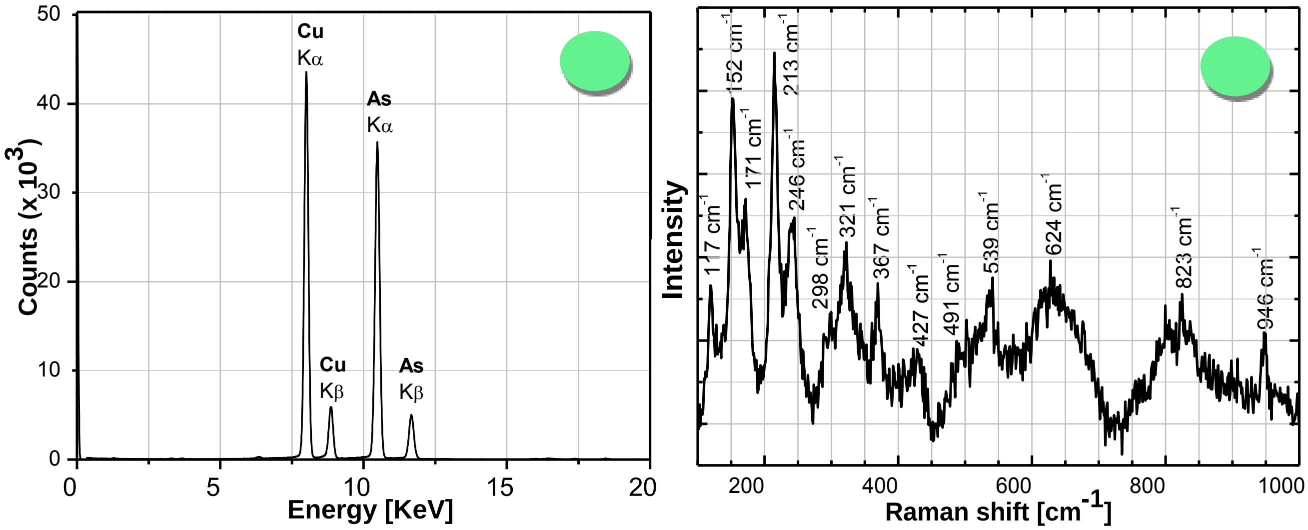


Figure 4.12. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra of emerald green coloured area acquired from p. 123 of *La Légende*.

- ***Yellow and orange coloured areas***

Yellow ochre is an earth pigment. It was identified with FORS in the yellow brownish areas of *La Légende de Saint Julien l'Hospitalier*. FORS spectrum of this pigment presents reflectance peaks ca. 450, 595 nm and 757 nm. The typical absorption bands are located ca. 486 nm, 653 nm and 950 nm due to the *d-d* transitions of Fe (III) ions, that are characteristic of the chromophore mineral goethite [α-FeO(OH)], which is by its turn the main component of the yellow ochre pigment [Bacci 2000, 342; Boselli 2010, 161; Aceto *et al.* 2014] (***Figure 4.13***). The maximum peak in the first derivative spectrum is located at ca. 545 nm [*see* ***Appendix A4.5***].

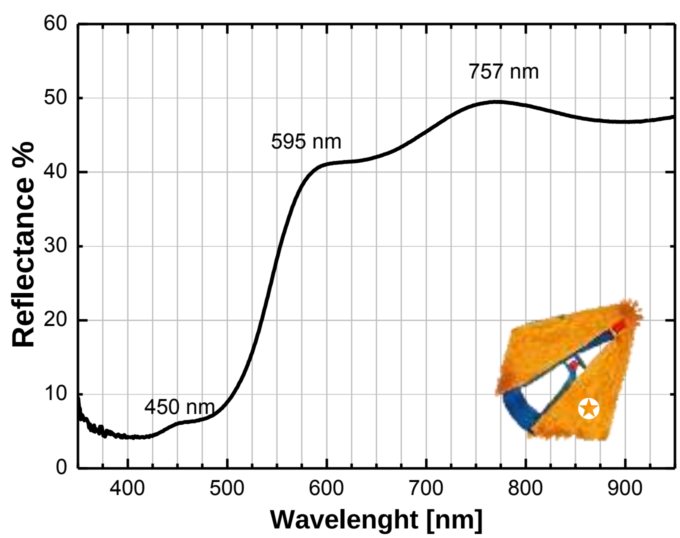


Figure 4.13. FORS spectrum of a yellow brownish coloured area acquired from p.123 of *La Légende*.

The element iron was the single element detected with μ-EDXRF in the analysed areas. Goethite is the yellow compound of yellow ochre pigment [Helwig 2007, 39]. μ-Raman analyses show a strong characteristic peak at ca. 544 cm^{-1} in the yellow letters present in the text in page 80, that is related with this compound [Legodi and Waal 2007; Bouchard *et al.* 2009; Montagner *et al.* 2013] (***Figure 4.14***). This corresponds to the asymmetric stretching of Fe–OH [Legodi and Waal 2007].

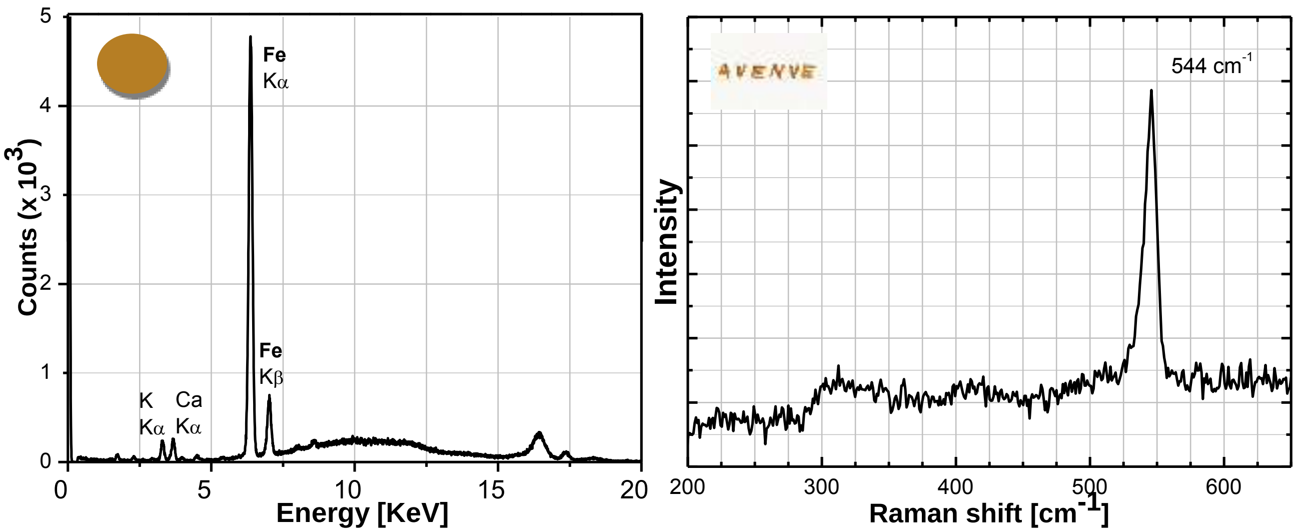


Figure 4.14. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra of yellow coloured area acquired from p. 123 (μ-EDXRF) and p. 80 (Raman) of *La Légende*.

Cadmium pigments exist in different colours from yellow to red [Fiedler and Bayard 1986, 65; Eastaught *et al.* 2008, 77].

Cadmium yellow was identified as the single yellow used by Amadeo in *La Légende*. This pigment can be either cadmium sulphide (CdS) or zinc in solid solution with CdS [(Cd, Zn)S]. However, the second variant is formed by a co-precipitation of cadmium sulphide and barium sulphate, resulting in a lithopone variant of cadmium yellow that was patented as pigment only in 1921, i.e. after Amadeo's death (1918) [Eastaught *et al.* 2008, 76]. So, it is not possible that this variant correspond to Souza-Cardoso's yellow colour in the manuscript. FORS spectra propose this pigment since they present the typical S-shaped spectrum (semiconductor) with an inflection point, determined by the first derivative, located at

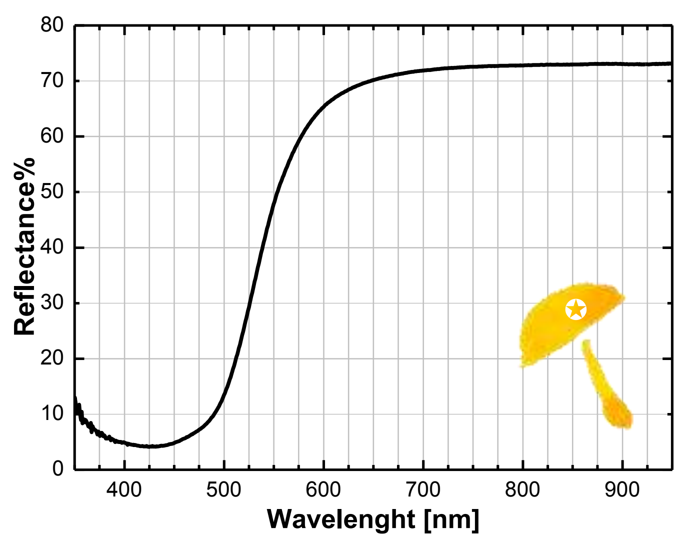


Figure 4.15. FORS spectrum from a yellow coloured area acquired from p.103 of *La Légende*.

ca. 530 nm and an absorption band centred at ca. 520 nm [*see* ***Appendix A4.5***] due to a band-to-band transition in cadmium [Fiedler and Bayard 1986, 70; Boselli 2010, 145] (***Figure 4.15***).

Analyses with μ-EDXRF allowed to detect the elements cadmium and sulphur in accordance with the CdS composition [Van der Snickt *et al.* 2009]. In agreement with the previous explanation, the traces of the element zinc detected with the technique may be associated to paper manufacture. However, other authors pointed out that being cadmium mined from zinc ores, the inclusion of zinc in the crystal lattice may be unintentional or coming from the original raw materials [Rosi *et al.* 2016]. When analysed with Raman with 632.8 nm excitation, a band at ca. 305 cm^{-1} is obtained and assigned to the longitudinal optical phonon longitudinal optic (LO) [Correia *et al.* 2007; Aguayo *et al.* 2010] (***Figure 4.16***).

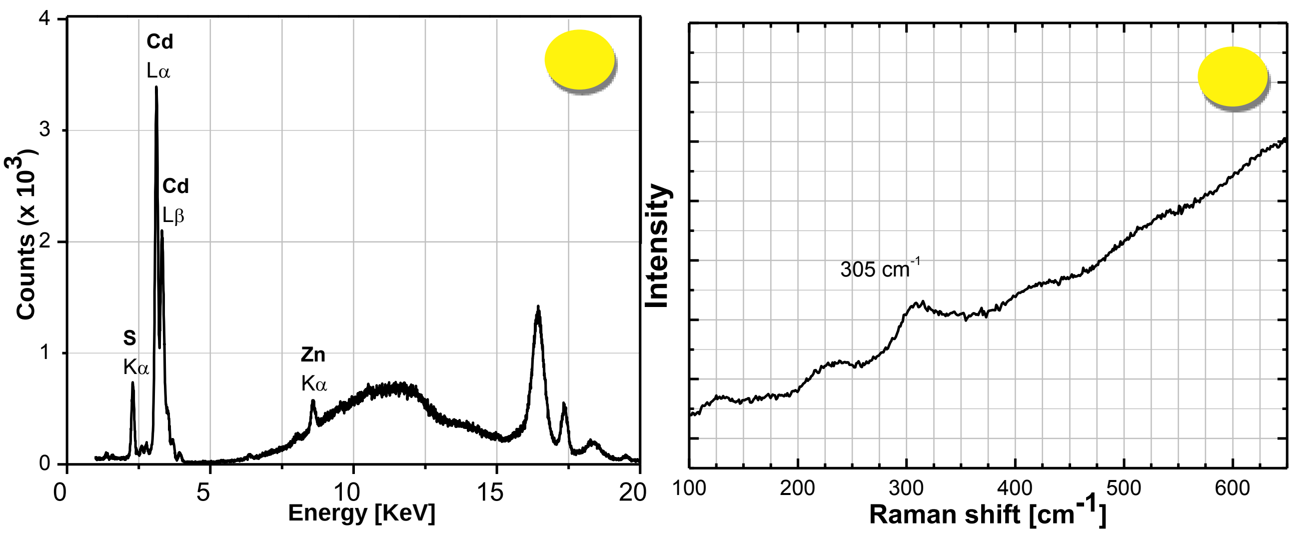


Figure 4.16. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra from cadmium yellow coloured area acquired from p. 103 of *La Légende*.

From the cadmium sulphides and selenides compounds group, cadmium orange presents an intermediary composition between cadmium yellow, previously mentioned and cadmium red [Cd(S,Se)] and it was identified in the orange painted areas of Amadeo's manuscript. Some formulations of this pigment may include mercury or zinc as substitute of cadmium [(Cd,Hg)S and (Cd,Zn)S], giving a variety of orange to maroon shades [Fiedler and Bayard 1986, 65; Eastaugh *et al.* 2008, 79]. Nevertheless, the mercury variant was developed in the 1940s, i.e also after Amadeo's death [Eastaught *et al.* 2008, 75].

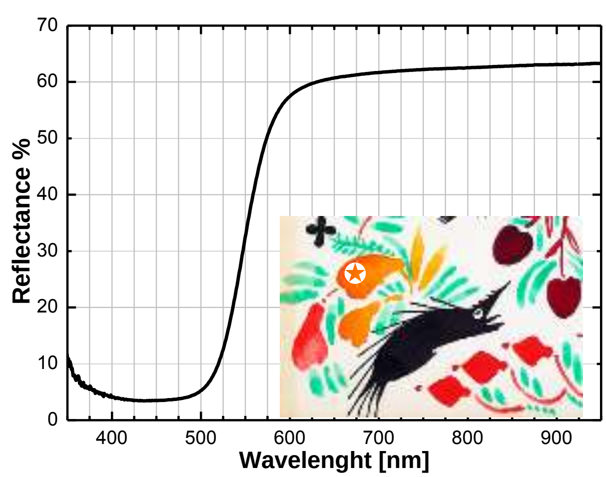


Figure 4.17. FORS spectrum from an orange coloured area acquired from p.80 of *La Légende*.

FORS S-shape spectra obtained (***Figure 4.17***) show an absorption band centred at ca. 450 nm. The first derivative indicates an inflection point at ca. 530 nm [*see* ***Appendix A4.5***], due to a band-band transition in cadmium [Fiedler and Bayard 1986, 70; Boselli 2010, 145].

The analyses with μ-EDXRF and Raman microscopy complemented this result. With μ-EDXRF, the elements cadmium, sulphur, selenium and zinc were detected, suggesting the copresence of [Cd(S,Se)] and [(Cd,Zn)S]. In what concerns Raman microscopy analyses, the spectra collected are similar to that of cadmium yellow, presenting a band at ca. 308 cm^{-1} as well [Montagner 2015, 230] (***Figure 4.18***).

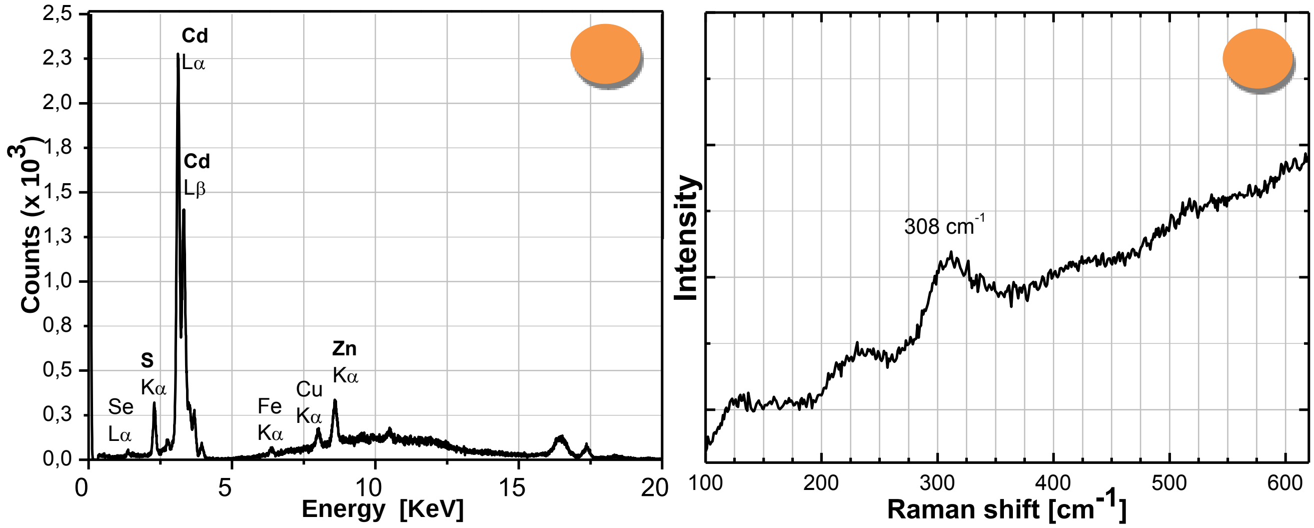


Figure 4.18. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra from cadmium orange coloured area acquired from p. 80 of *La Légende*.

- ***Red coloured areas***

Analysis with FORS on the red coloured areas of the manuscript present the same behaviour: S-shaped spectra with inflection point located at ca. 600 nm (***Figure 4.19***), typical of the red inorganic pigments vermilion and cadmium red (cadmiumsulfoselenide) [Cd(S,Se)] [*see* ***Appendix A4.5***]. It may be attributed to the band-to-band electronic transition that occurs in both cases [Bacci 2000, 342; Boselli 2010, 163]. Thus, FORS does not allow the distinction between these pigments[260] [Bacci *et al.* 2009b, 199; Delaney *et al.* 2010].

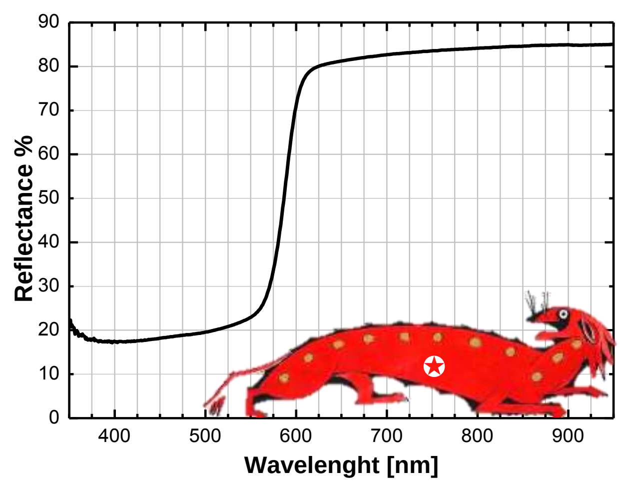


Figure 4.19. FORS spectrum from a red coloured area acquired from p.131 of *La Légende*.

[260]Cf. IFAC-CNR database: http://mowcres.fors.ifac.cnr.it/ [Red].

Vermilion is mercury sulphide (α-HgS) [Miguel *et al.* 2014]. The μ-EDXRF spectra obtained in the same areas identified the presence of the element mercury, consistent with the vermilion assignment [Howard *et al.* 2012]. Raman technique also confirmed this result. The spectra collected present bands at ca. 251, 282 and 343 cm^{-1} [Correia *et al.* 2007; Abdel-Ghani 2015]. The band at ca. 251 cm^{-1} may be assigned to the Hg-S stretching vibrations [Abdel-Ghani 2015]. Thus, vermilion is the colorant present in the red painted areas of the illustration (***Figure 4.20***).

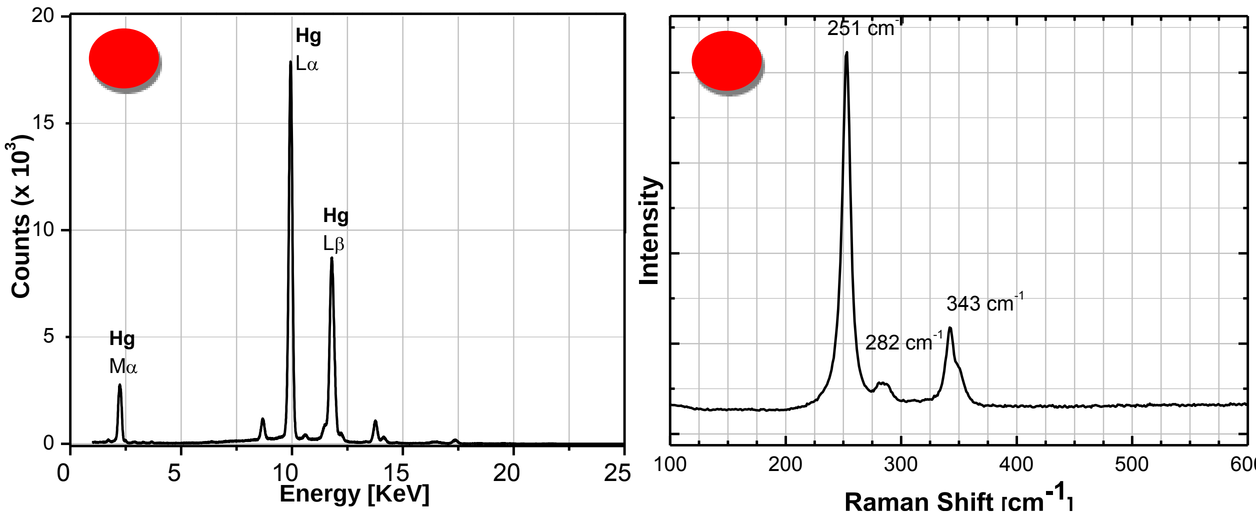


Figure 4.20. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra from vermilion coloured area acquired from p. 131 of *La Légende*.

- ***Bordeaux coloured areas***

Following the paradigm of Bisulca *et al.* (2008) and Vitorino *et al.* (2015), carmine[261] (cochineal lake[262]) seems to be identified in the *bordeaux* painted areas. When the paint layer is less saturate, the respective FORS spectra show a peak of reflectance at ca. 418 nm two sub-bands at ca. 520-565 nm, as mentioned by those authors. This S-shape spectrum shows an inflection point at ca. 598 nm is observable as well [*see* ***Appendix A4.5***]. According to the authors, in the visible range, the spectra

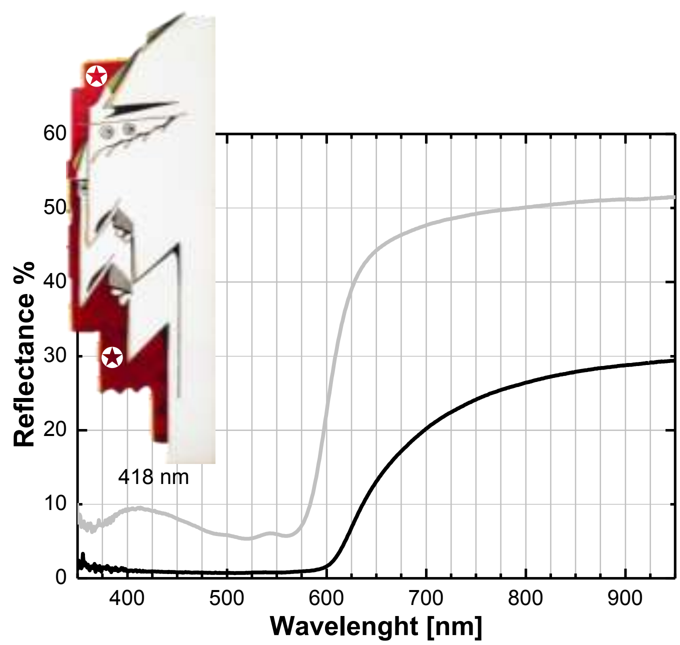


Figure 4.21. FORS spectrum from a *bordeaux* coloured area acquired from p.134 of *La Légende*. (Note: the grey line refers to the less saturate *bordeaux* area).

[261]Carminic acid: $C_{22}H_{20}O_{13}$.

[262] "Lake" is the result from the precipitation of a chromophore in solution with metal salts (e.g. alum) [Claro *et al.* 2010].

behaviour presented is due to the transitions n→π* of the carbonyl groups, that occur in the anthraquinone based dyes. From the studies cited, carmine presents absorption bands at ca. 520 nm and 557 nm that are in agreement with those from the present case study in investigation (***Figure 4.21***). In the more saturate areas, the peaks in the Vis region are not observable. The S-shape spectrum in those cases, present and inflection point at ca. 611 nm [*see* ***Appendix A4.5***].

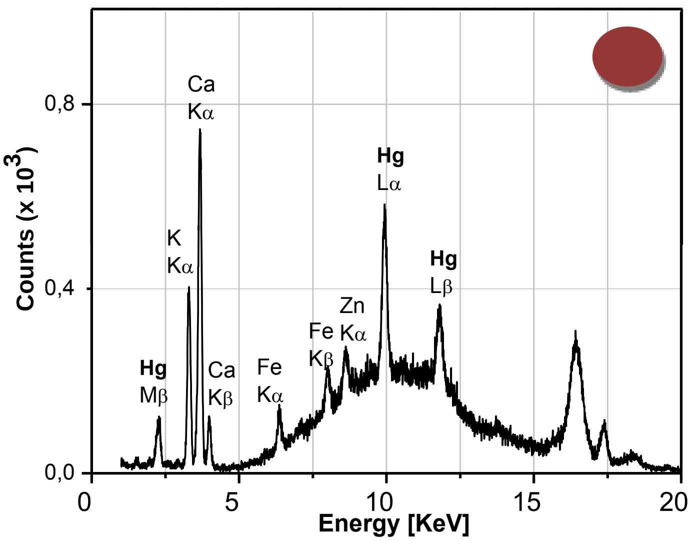


Figure 4.22. μ-EDXRF spectrum from a carmine coloured area acquired from p.134 of *La Légende*.

In addition, μ-EDXRF analyses were not able to contribute to the identification of the colourant present. The spectra are dominated by the peaks of the elements associated to the influence of paper. Nevertheless, the technique detected the element mercury. This seems to indicate that the paint has a portion of vermilion mixed in it[263]. This combination was common to find in some commercial brands of artists materials. Vermilion was used to adulterate intentionally carmines improving their colours [Harley 2001, 138; Carlyle 2001, 507] (***Figure 4.22***). Raman microscopy, with the used laser (632.8 nm) was not efficient in this situation, making not possible the identification of the colourant present.

- ***Black coloured areas***

Concerning the black painted areas, FORS was not able to identify the colorant present because of the very low reflectance values (***Figure 4.23***) [Boselli 2010, 154]. With μ-EDXRF, the elements associated to paper were identified not giving any information concerning the pigment present. However, with μ-Raman two bands at ca. 1358 and 1580 cm^{-1} were identified indicating the presence of a carbon-based black pigment in the Chinese ink formulation [Bell *et al.* 1997; Marcelino and Muralha 2012; Manso *et al.* 2013], (***Figure 4.24***). According to literature, Chinese

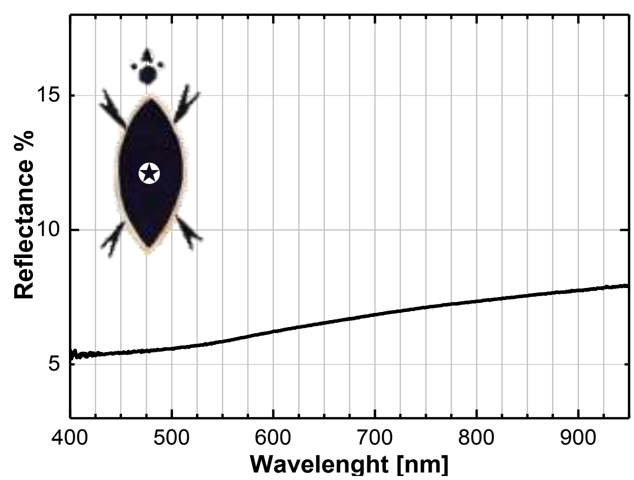


Figure 4.23. FORS spectrum of a black coloured area acquired from p.116 of *La Légende*.

[263]From the analysis of Amadeo's pictorial technique by stereomicroscopy, as presented in *Chapter 3*, the hypothesis of an eventual superposition of paint layers i.e. vermilion under carmine is not plausible.

ink is composed by lamp black (Carbon) that presents these Raman features [Ure 1870, 404; Eastaugh *et al.* 2008, 222].

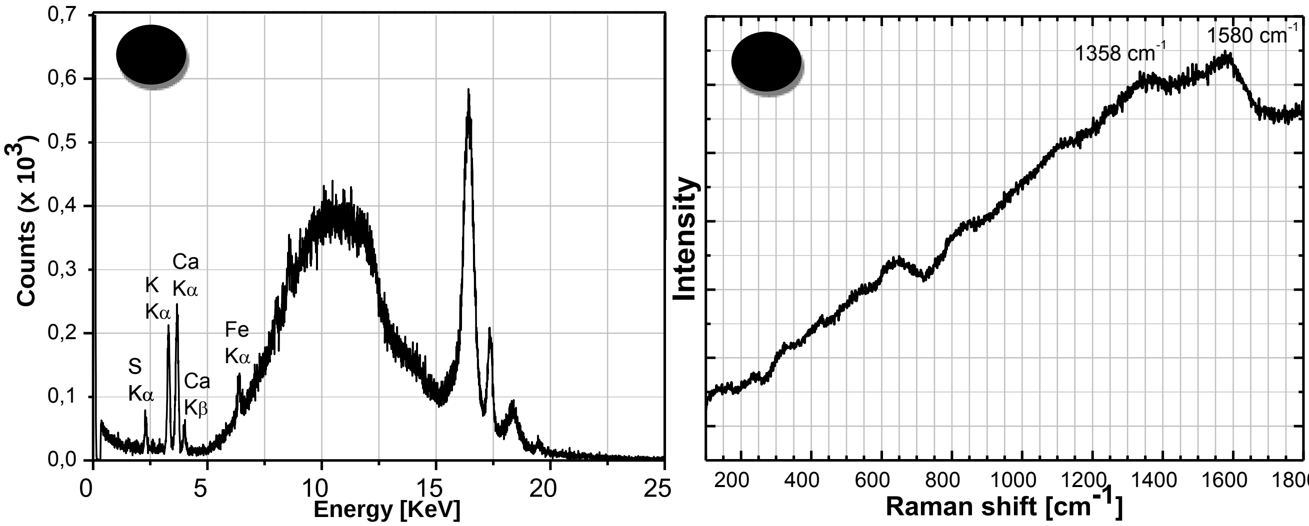


Figure 4.24. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra from Chinese ink (lamp black) coloured area acquired from p. 116 of *La Légende*.

- ***Gold coloured areas***

Gold was identified in the golden areas pages. The FORS spectra obtained are in accordance with literature [Aceto *et al.* 2014]. An S-shaped spectrum with inflection point at ca. 515 nm is observed [*see* ***Appendix A4.5***]. The spectrum of this metallic colorant (conductor) is more "rounded" respect to the semiconductors [Aceto *et al.* 2014]. μ-EDXRF technique detected also the element gold corroborating FORS result (***Figure 4.25***). The presence of copper may suggest the mixture of finely divided copper powder. Gold cannot be detected through Raman spectroscopy [Chaplin *et al.* 2006].

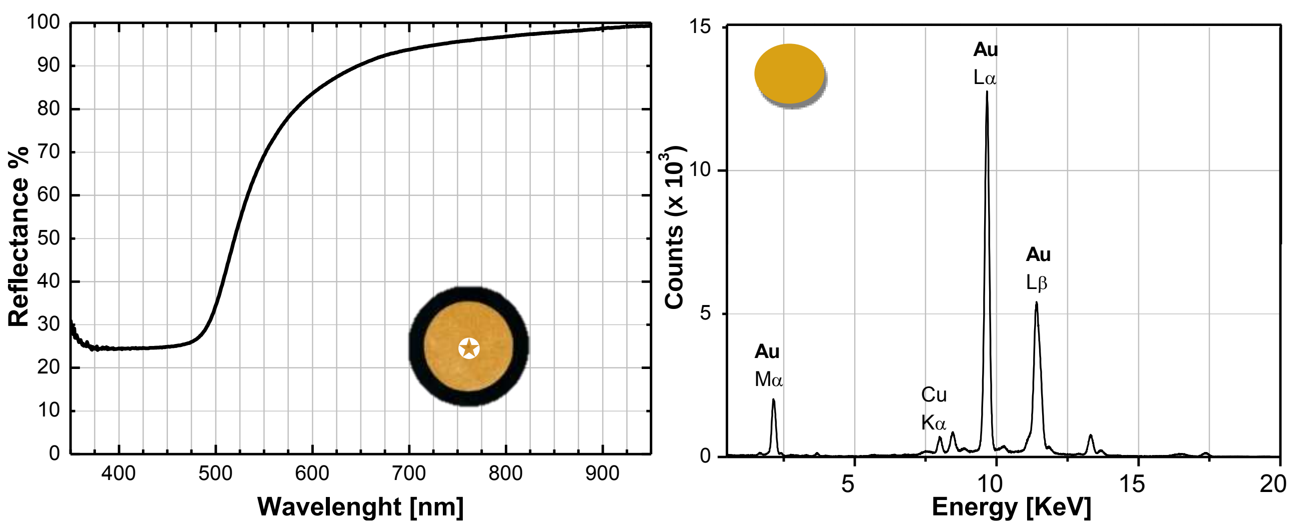


Figure 4.25. FORS (*left*) and μ-EDXRF (*right*) spectra from gold coloured area acquired from p. 137 of *La Légende*.

- ***Silver coloured areas***

Silver was detected in the silver coloured areas of *La Légende*. As indicated in ***Chapter 3***, in some of them, especially in the borders of the pages, silver presents darkening from a degradation process.

FORS spectra of this metallic pigment when unaged, usually present an inflection point at ca. 330 nm. However, when silver turns into silver sulphide, the inflection point observed in reflectance spectra is hardly apparent [Aceto *et al.* 2014]. Moreover, it starts reflecting from the cyano-green region up to higher wavelengths (***Figure 4.26***).

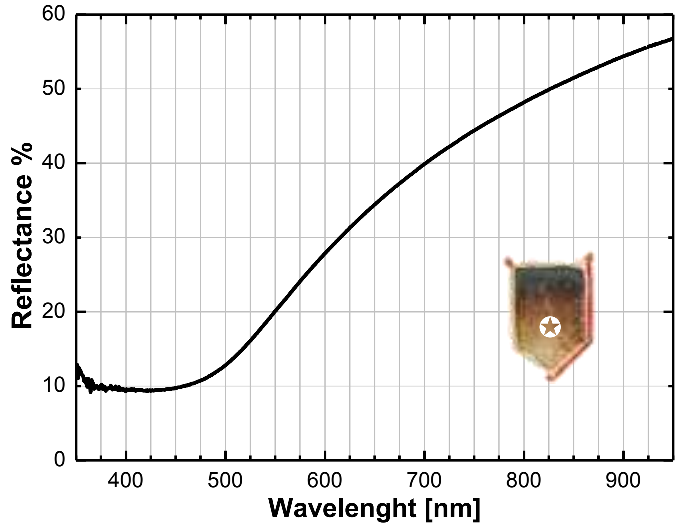


Figure 4.26. FORS spectrum of silver coloured area acquired from p.105 of *La Légende*.

With μ-EDXRF analyses, the element silver was detected as well as sulphur and chlorine. Raman microscopy analysis detected also the presence of silver chloride in the dark areas of the coat of arms located in the top of page 105. Its characteristic bands were observed at ca. 100 and 232 cm^{-1} [Martina *et al.* 2012; Martina *et al.* 2013]. Furthermore, the results obtained from μ-EDXRF also suggest the presence of silver sulphide which is an indicator of a degradation process occurring in this metallic pigment (***Figure 4.27***). Further information on the mechanisms of silver degradation is presented in ***Appendix A4.6***.

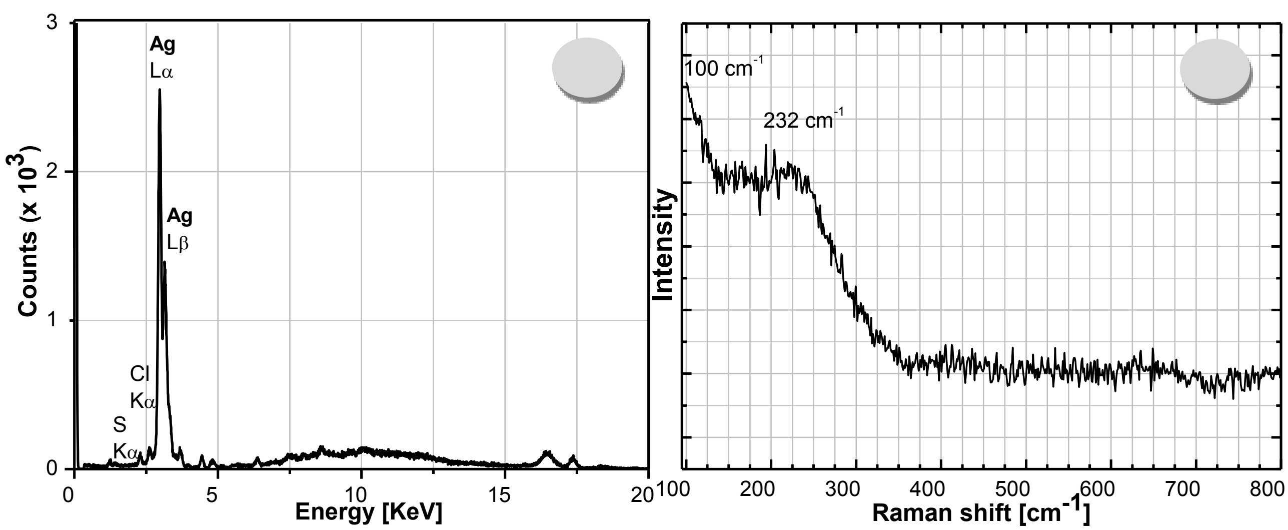


Figure 4.27. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra from silver coloured area acquired from p. 105 of *La Légende*.

4.3.2 Colourants in the handwritten text

On the handwritten text, several of the previous colour materials were identified as further reported in ***Table 4.2***. In addition, cobalt blue (cobalt aluminium oxide, $CoO{\cdot}Al_2O_3$) was identified on the text (p. 65). With FORS the characteristic spectrum of this pigment was established due to the presence of two absorption bands, related with a ligand-field transition between *d-d* orbitals of Co (II) with a pseudo-tetrahedral coordination in the aluminium (III) oxide lattice, which create two typical strong absorption bands. These bands are divided into three sub-bands, in the 550-650 nm and 1200-1500 nm ranges. The sharp and weak absorption band at around 480 nm may be due to a spin forbidden quartet-doublet transition, which gains in intensity through interaction with the near spin allowed electronic transitions [Bacci and Picollo 1996; Bacci *et al.* 2009] (***Figure 4.28***). Analyses with μ-EDXRF identified the element cobalt, characteristic of cobalt blue [Calza *et al.* 2010]. The element nickel was also detected, probably from impurities [Bezur and Casadio 2012, 268]. Raman spectra of these areas present high fluorescence background. However, a very weak band at ca. 203 cm^{-1} is observed which is characteristic of cobalt blue [Correia *et al.* 2007; Bouchard and Gambardella 2010] (***Figure 4.29***).

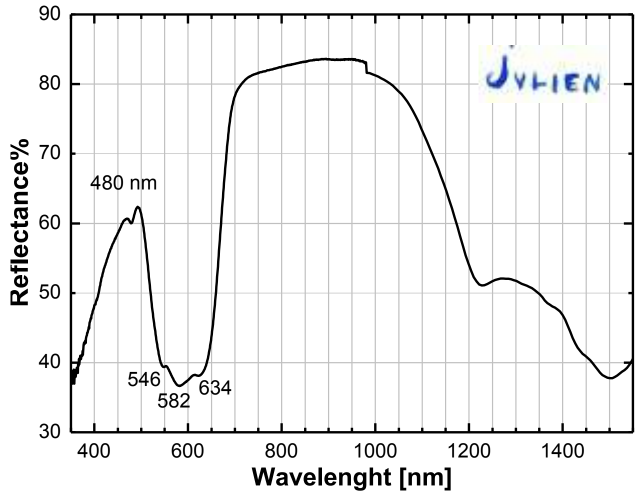


Figure 4.28. FORS spectrum from the blue letters acquired from p. 65 of *La Légende*.

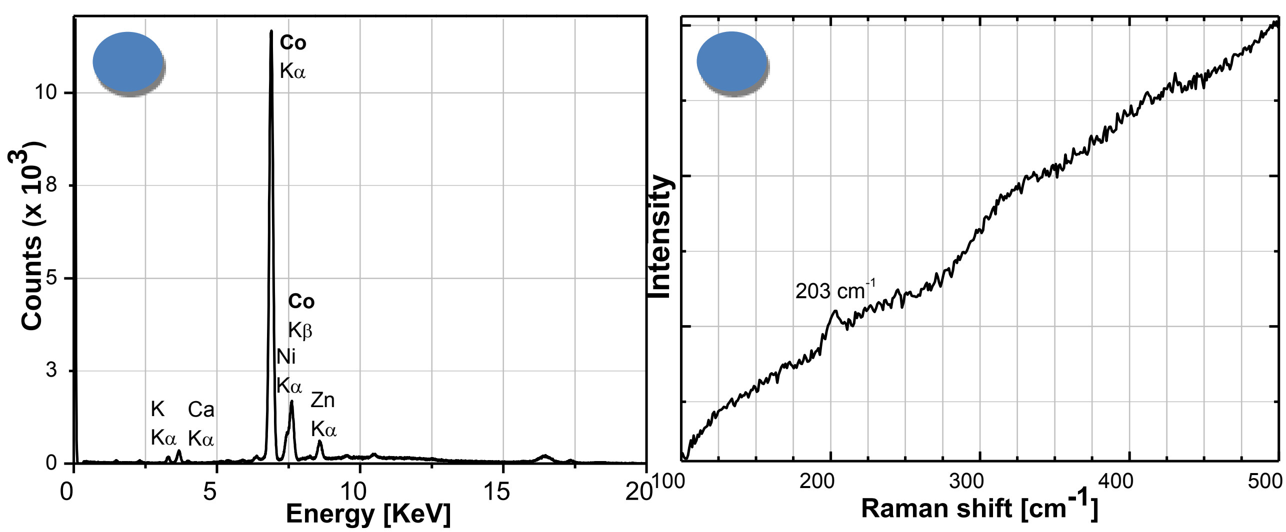


Figure 4.29. μ-EDXRF (*left*) and Raman microscopy (*right*) spectra from cobalt blue coloured letters acquired from p. 65 of *La Légende*.

Cobalt green (cobalt oxide-zinc oxide, CoO·nZnO) was also identified in p. 80. FORS indicates the presence of this pigment due to the identification of its features: a strong absorption band in the visible range which is divided in three sub-bands located at ca. 563, 606 and 658 nm. It is also possible to observe another strong absorption band in the NIR range, sub-divided in three bands at ca. 1306, 1440 and 1655 nm. These absorption bands are related with the transitions *d-d* of the Co (II) ion in a tetrahedral coordination [Miliani *et al.* 2007]. Through μ-EDXRF, the combination of the elements cobalt and zinc characteristic of this pigment was detected [Calza *et al.* 2010] (***Figure 4.30***).

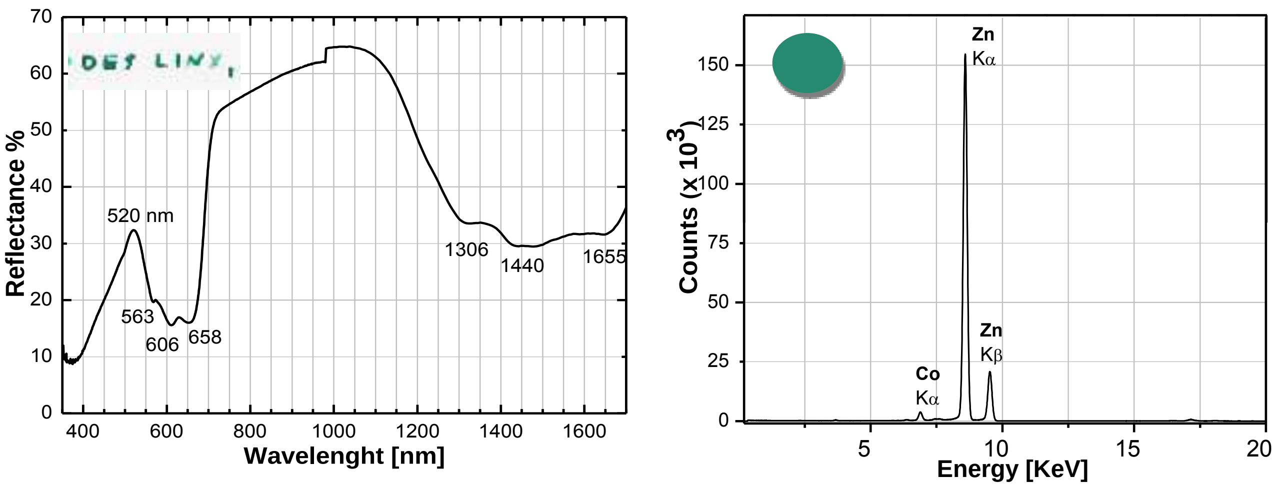


Figure 4.30. FORS (*left*) and μ-EDXRF (*right*) spectra from cobalt green coloured letters acquired from p. 80 of *La Légende*.

With FORS, burnt sienna that is a mixture of iron oxides, silica and clay, was identified in p. 60, since the obtained spectra present a reflectance peak at ca. 760 nm and an absorption band centred at ca. 850 nm *d-d* transitions of Fe (III), typical of iron oxide minerals [Bacci 2000, 342; Boselli 2010, 144; Aceto *et al.* 2014] (***Figure 4.31***). With μ-EDXRF, a significant concentration of iron was detected as expected for this pigment [Van der Snickt *et al.* 2011].

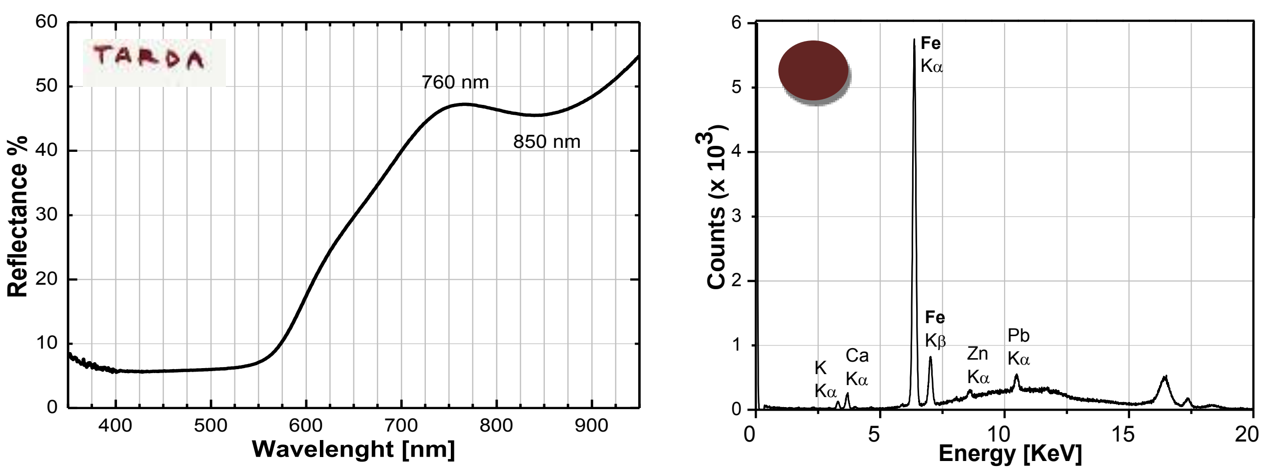


Figure 4.31. FORS (*left*) and μ-EDXRF (*right*) spectra of burnt sienna coloured letters acquired from p. 60 of *La Légende*.

As mentioned in ***Chapter 3***, a scarlet colorant was profusely used by the artist during the copy of Flaubert's tale and observed in the text of a great number of pages, especially, in the second and third chapters of the book. It was also used to delineate the contour of the weapon represented in p. 99 [*see Résumé* of results in ***Appendix A4.4***]. The behaviour of FORS spectrum (***Figure 4.32***) can be ascribed to the presence of an organic pigment. The maximum peak in the first derivative spectrum is located at ca. 580 nm and the absorption bands are located at ca. 405, 492 and 523 nm [*see* ***Appendix A4.5***], which seems to correspond to a xanthene dye – eosin Y (Yellowish) ($C_{20}H_6Br_4Na_2O_5$, C.I. 45380/Acid red 87), a fluorescein derivative [*Colour Index* 1975, 414; Eastaugh *et al.* 2008, 157; Sabnis 2010, 173; Montagner *et al.* 2011]. The absorption bands referred can be assigned to electronic transitions from the highest occupied molecular orbital (HOMO) to the lowest unoccupied molecular orbital (HUMO), centred on the xanthene-like chromophore portion of the eosin Y molecule [Greeneltch *et al.* 2012]. μ-EDXRF spectra recorded from the analysis of these letters detected the presence of the element bromine (***Figure 4.32***), fact that corroborates with the characterisation through FORS.

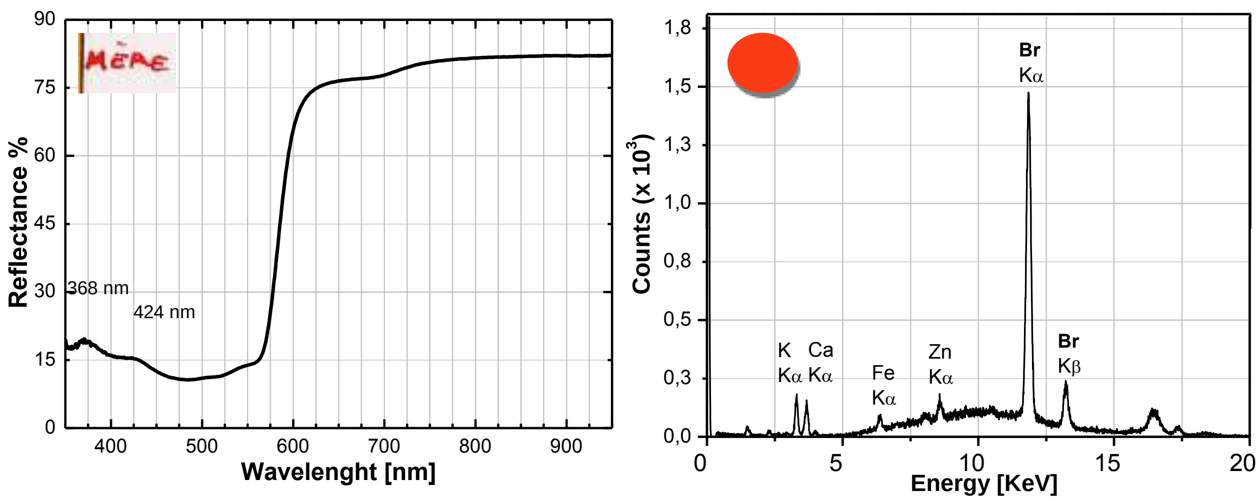


Figure 4.32. FORS (*left*) and μ-EDXRF (*right*) spectra acquired from scarlet coloured letters from p. 99 of *La Légende*.

Eosin Y was discovered by the German chemist Heinrich Caro (1834-1910), director of the German company *Badisch Anilin – und Sode-Fabrik*, in 1874 [Reinhardt and Travis 2000, 162; Eastaugh *et al.* 2008, 157; Kay 2015]. It is a bright red synthetic dye produced by the action of bromine on fluorescein ($C_{20}H_{12}O_5$) [Kay 2015]. Eosin showed to be an excellent dyestuff, especially for silk [Reinhardt and Travis 2000, 181]. According to sources from the late 19^{th} century and early 20^{th} century, the presence of eosin in the formulations of red writing inks is reported [Hopkins 1892, 283; Ebert 1897, 422; Martin 1913, 491].

μ-Raman results also confirm the presence of eosin Y in Amadeo de Souza-Cardoso's handwritten text (***Figure 4.33*** and ***Table 4.2***).

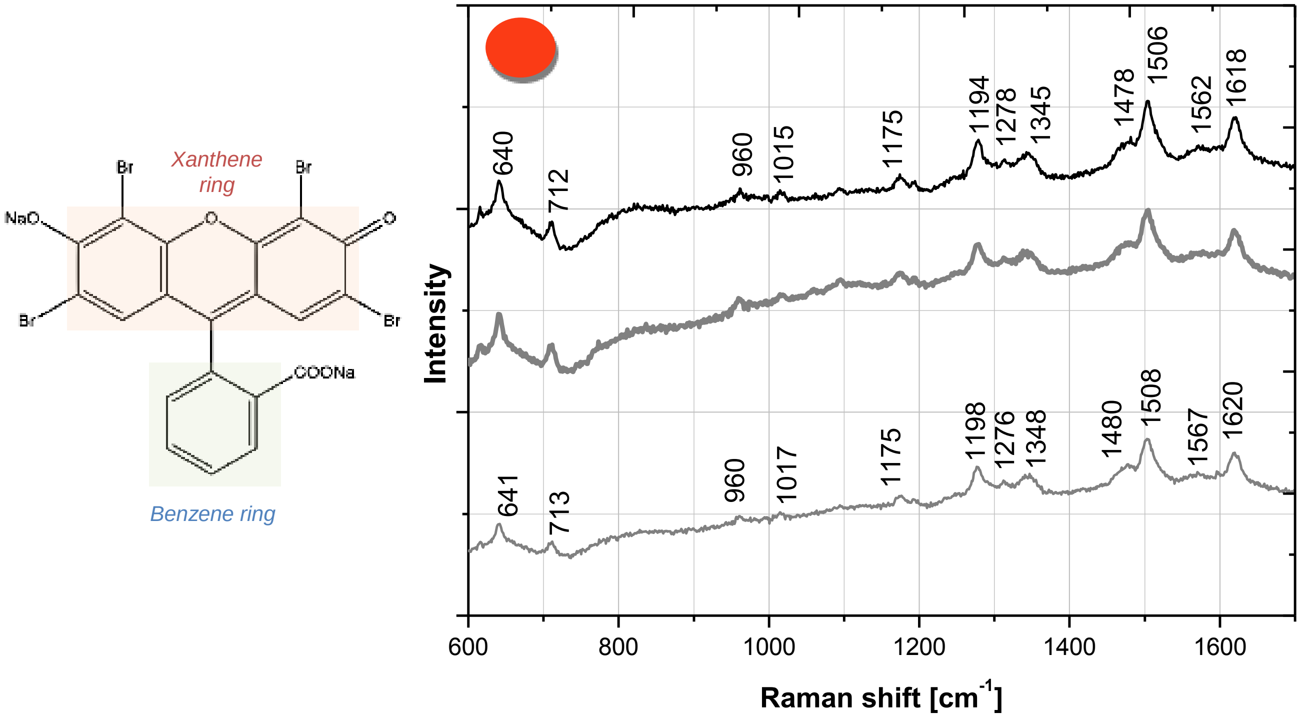


Figure 4.33. *On the left:* A molecular structure of eosin Y (According to Sabnis 2010, 173). *On the right:* μ-Raman spectra acquired from scarlet coloured letters from p. 99 (light grey lines), from p. 116 of *La Légende*.

Table 4.2 Raman modes for the eosin Y molecule [Whitney *et al.* 2006; Greeneltch *et al.* 2012].

Experimental peaks [cm^{-1}]	Attributions
ca. 1618	Xanthene ring C-C stretches
ca. 1562	Xanthene ring stretches and symmetric carbonyl C-O stretches
ca. 1506	Benzene ring stretches and asymmetric CO_2 stretches
ca. 1478	Xanthene (perpendicular) and benzene ring C-C stretches
ca. 1345	Xanthene ring C-C stretches
ca. 1278	Xanthene and benzene ring C-C stretches
ca. 1194	Xanthene ring C-C stretches
ca. 1175	Xanthene ring C-O and C-C stretches
ca. 1015	Xanthene ring breathing and C-Br stretches
ca. 960	Xanthene and benzene ring stretches
ca. 712	Xanthene out of plane ring deformation
ca. 640	Xanthene breathing and benzene breathing

4.4 Binding medium

In a painting, binding media are the invisible components that promote colours cohesion and adhesion. Binders may also influence the perception of colours [Melo *et al.* 2011]. The μ-Raman equipment used did not allow the identification of the binding media present in *La Légende de Saint Julien l'Hospitalier* colours, due to the strong fluorescence background. Within the wavelength working range of the FORS system (350-2200 nm), paper presents strong signals that tend to partially or totally hide the spectral features from most of the binding media. However, it was decided to extract as much as possible information from the available FORS data. Thus, FORS spectra acquired on *La Légende* were compared with those from two sets of mock-ups prepared in laboratory and spread on laboratory *Whatman* paper. They were prepared using Arabic gum (polysaccharide) and egg white (protein), two of the most common binding media present in manuscripts[264]. The experimental procedure for the preparation of laboratory mock-ups is described in ***Appendix A4.7***. The comparison between spectra of *La Légende*'s paper with laboratory samples reveals only slight differences (***Figure 4.34***). To further elucidate about those differences, a chemometrics approach is suggested in order to better evaluate the consistency of these slight spectral differences (***Appendix A4.7***).

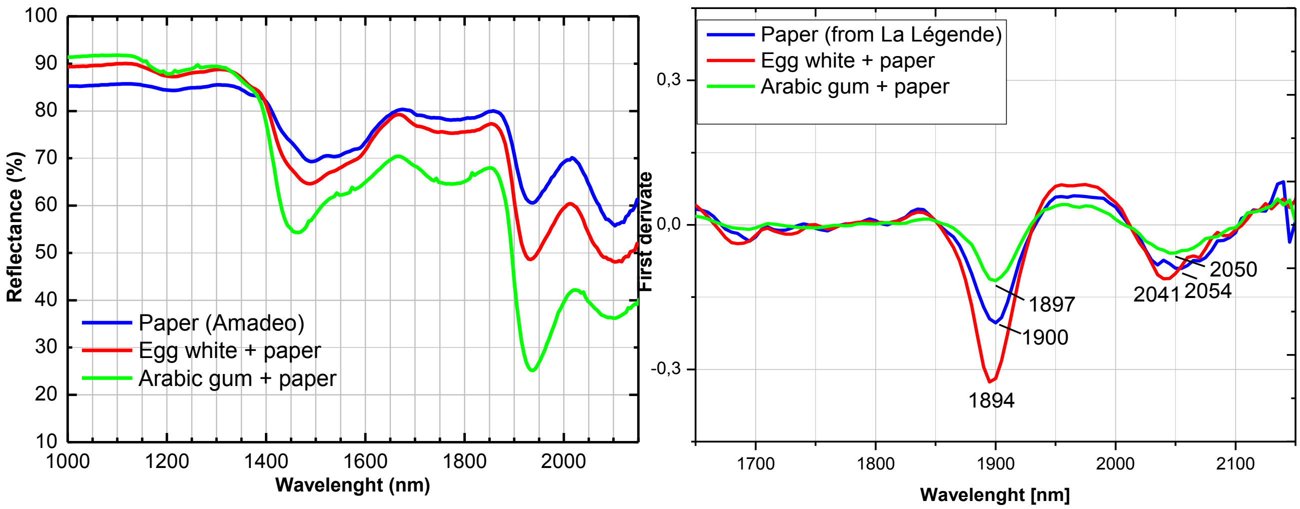


Figure 4.34. *On the left:* FORS spectra of paper, egg white+paper and Arabic gum+paper (geometry of analysis 8º/8º). *On the right:* The respective first derivate spectra in the range 1720-2120 nm.

Aiming at amplifying the differences between the obtained spectra, a chemometrics approach using the principal component analysis (PCA) method was applied to these FORS spectra to tentatively identifying the presence of either egg white and/or Arabic gum in Amadeo's colours in this manuscript. FORS spectra, which were acquired from Amadeo's paper and from the mock-ups prepared in the laboratory, were used as calibration references to build the PCA model. The model was calibrated considering the restricted region corresponding to the NIR range between 1722 and 2120 nm. In this wavelength interval, none of the characteristic features related with the pigments were present in the spectral signal and therefore will not interfere with the analysis. Artist's colours' samples, were chosen from viridian (p. 123 of *La Légende*), yellow ochre (p. 123), cadmium yellow (p. 97 and 99), cadmium orange (p. 2 and 91), carmine (p. 134), emerald green (p. 97 and 99), ultramarine blue (p. 99) and vermilion (p. 123) to test the developed PCA model tentatively aiming at confirming the presence of one or both binders. As observed in ***Figure 4.34***, the spectral differences between: paper from an Amadeo's

[264]Cf. Cennini 2003, 315; Ricciardi *et al.* 2012; Mas *et al.* 2014. Arabic gum was also selected since it is the common binding medium present in watercolours as already referred in *Chapter 3* (Cf. also W&N 19th century recipes archive).

manuscript, Arabic gum, Arabic gum+paper and egg white+paper are minor. First derivative of the spectra does not show either remarkable difference (note that the level of spectral resolution did not allow a more detailed spectral comparison).

Figure 4.35 displays the score plot from the PCA model applied to the FORS spectra of the binding media, paper and Amadeo's paints. As observed, there is a clear separation between the paper and paper+binders.

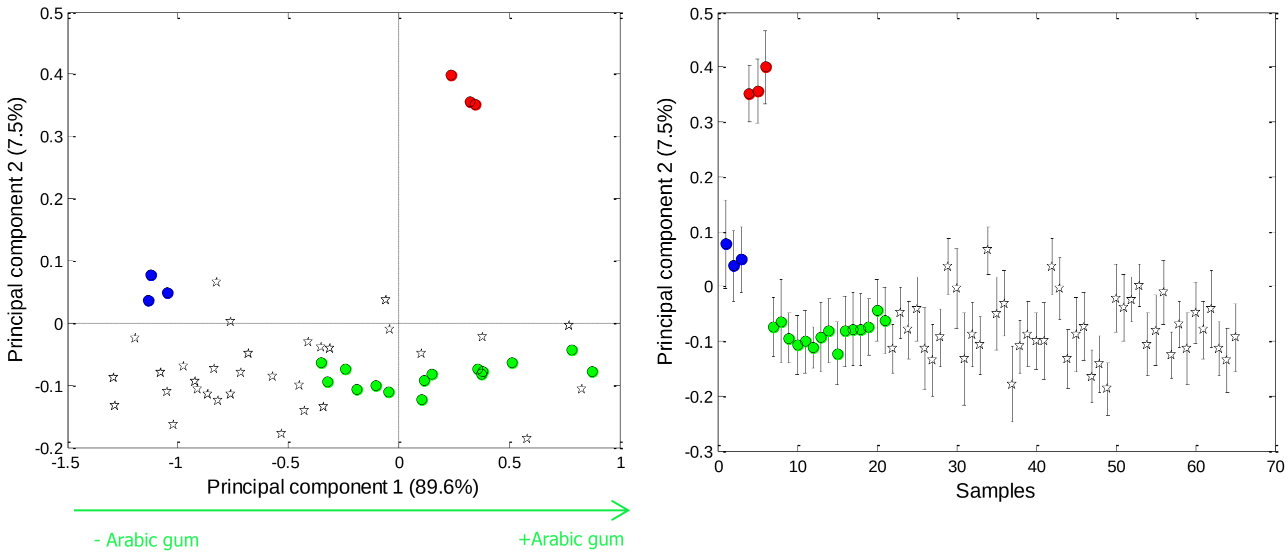


Figure 4.35. *On the left:* Score plot. *On the right:* Second principal component with representation of 95% confidence intervals estimated with bootstrapping (● paper, ● paper+egg white, ● paper+Arabic gum (10-50%), ☆Amadeo samples).

The first component separates paper from the binders while the second component separates paper+egg white. As both binders were produced on the same support, it can be anticipated that the first score might be related with the support (paper). Additionally, there is some dispersion of the scores corresponding to Arabic gum samples in the same component. This is due to the different Arabic gum concentrations (from 10 until 50%) in samples: on the left, the most diluted and on the right, progressively, the most concentrated (green arrow). Therefore, the model captured in the first component both the spectral signal characteristic to *La Légende*'s paper and Arabic gum. As the concentration of Arabic gum decreases towards the left side of the score plot, it makes sense the positioning of the *La Légende*'s paper samples (Arabic gum free). The second component reflects clearly the presence of egg-white. As observed in the same figure, Amadeo's samples projections are located in the same axis spanned by laboratory-made Arabic gum samples. These samples also vary along this axis thus indicating the presence of Arabic gum in different quantities which was expected according to the characteristics of the paint layers in watercolour painting technique [*see* ***Chapter 3, section 3.3***]. Note that Amadeo's samples projections are shifted towards negative values of the first component which is also perfectly expected as the matrix is similar to Amadeo's paper used in the PCA model calibration (blue circles).

There is no indication of presence of egg-white in Amadeo's colours whatsoever (note that none sample is shifted towards high values of the second principal component). This is evident in the right panel of ***Figure 4.35*** where the second component is represented alone and there is a clear overlap between laboratory samples containing Arabic gum and Amadeo's colours. In brief, this method suggests that the binding medium present in the paints used by the artist is probably Arabic gum in different concentrations.

To further confirm this hypothesis, a multivariate curve resolution method could be applied to the same spectra with the intention of separating the mixed effect of the paper matrix and Arabic gum together in the first component. However to test this hypothesis more spectra from Amadeo's paper and laboratory samples are required as there is a great level of NIR spectra matching between these two materials [*see* ***Figure 4.34***].

4.5 Other materials present in the manuscript

- ***Page numbers***

The page numbers seem to have been written with a violet pencil. The areas were only analysed with FORS due to the tinny area available to analysis. Due to the thickness of the handwriting, the spectra obtained present some influence of the substrate (paper). The behaviour of these spectra presents a reflectance peak at ca. 480 nm and an absorption band at ca. 585 nm which, in comparison with the spectrum presented in ***section 4.2.1*** seem to correspond to the presence of cobalt violet in the writing material (***Figure 4.36***).

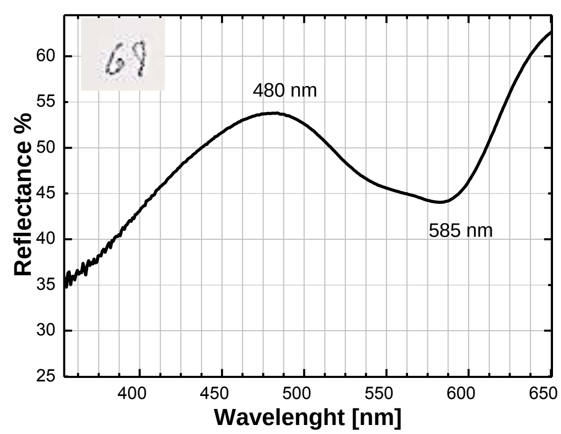


Figure 4.36. FORS spectrum from page number from p.68 of *La Légende*.

- ***Cover boards and head of the pages***

On the cover boards of the book, parchment was confirmed with FORS methodology as the cover material. In the NIR region, the overtone and combination bands of water are observed at ca. 1456 and 1940 nm. Bands attributed to CH groups in lipids and proteins are present at ca. 1731 nm. Finally, ca. 1560 and 2050 nm two weak bands due to the first overtone of the N-H stretching and NH_2 stretching of the $CONH_2$ group of collagen were observed [Badea *et al.* 2008; Miu *et al.* 2008] (***Figure 4.37***). μ-EDXRF analyses detected the elements sulphur, calcium, iron, copper, zinc and lead which may be related with parchment as well as with the cardboards [*see* ***Appendix A4.3***] [Doherty *et al.* 2013; Manso *et al.* 2013].

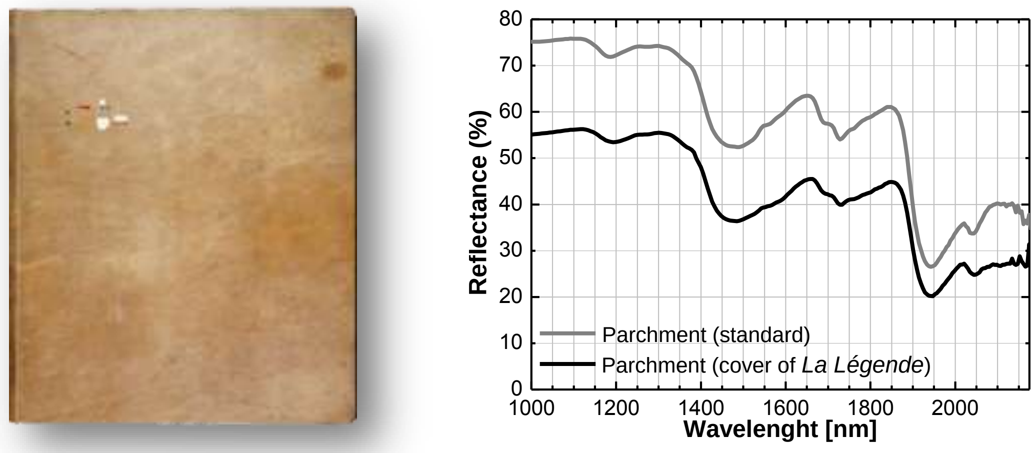


Figure 4.37. FORS results on the cover boards of *La Légende de Saint Julien l'Hospitalier*.

The remains of three small coats of arms present on the upper board were observed and analysed (***Figure 4.38***). Emerald green was identified in the green areas, vermillion in the red ones, and ultramarine blue in the bluish [*see* ***Appendix A4.3***]. In what respects the white painted areas, lead and zinc were identified with μ-EDXRF. This fact seems to indicate the presence of *Foundation white*[265], a current commercial term at Amadeo's time to designate a mixture of lead white [$2PbCO_3{\cdot}Pb(OH)_2$] and zinc white (ZnO) [Carlyle 2001, 173; Eastaugh *et al.* 2008, 166]. The obtained FORS spectrum of the same area corroborates this result. It presents a typical S-type absorption band shape and an inflection point at ca. 384 nm characteristic of zinc white [*see* ***Appendix A4.5***] [Picollo *et al.* 2007; Delaney *et al.* 2010] (***Figure 4.38***). Moreover, the entire visible region presents high reflectance values characteristic of white pigments. In the NIR range, this spectrum shows a typical absorption band of hydrocerussite (lead white) at ca. 1445 nm is due to the hydroxyl group first overtone of the stretching mode vibrations [Bacci *et al.* 2007; Delaney *et al.* 2010; Silva *et al.* 2011]. In addition, the absorption doublet observed at ca. 1728 nm and 1766 nm is due to the first *overtone* of the fundamental vibrations, respectively, from the asymmetric and symmetric stretching of the group -CH_2. The small absorption band observed at ca. 1214 nm occurs due to the second *overtone* of the group -CH_2. At ca. 1942 nm, the observed absorption band is due to a combination of stretching and bending modes of water [Dooley *et al.* 2013]. However, the reduced working range of the FORS device used, does not allow the identification of the binding medium present in the coats of arms.

[265]According to Carlyle, *Foundation white* was introduced in the late 1880s or early 1890s by *Winsor & Newton*, *Reeves* and *Rowney* [Carlyle 2001, 515].

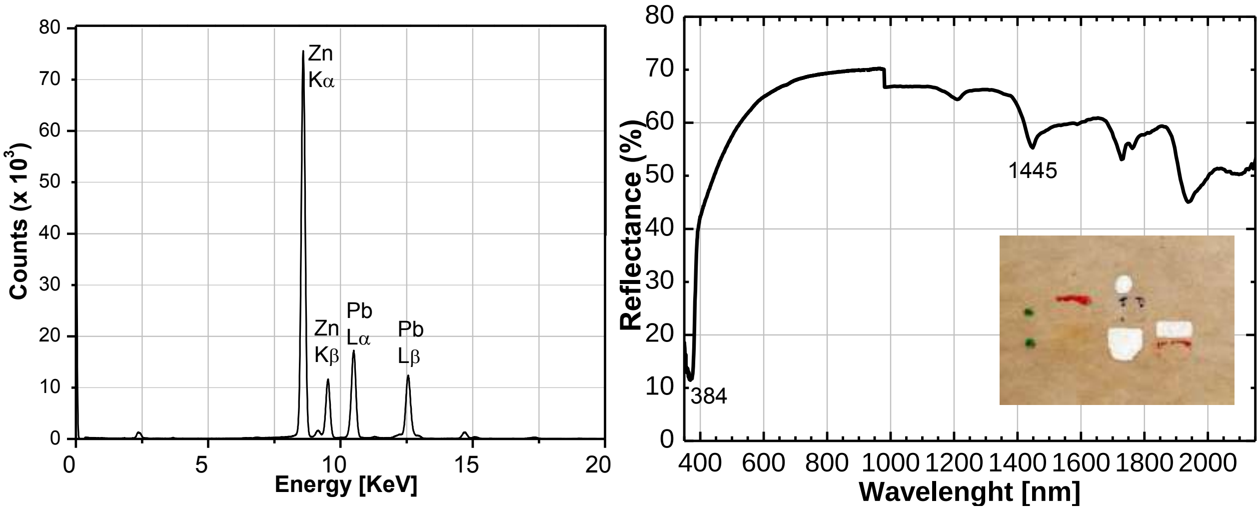


Figure 4.38. μ-EDXRF (*left*) and FORS (*right*) spectra acquired from the white painted coat of arms.

In book analysis the head-edge usually is not easily accessible. Due to the system of fibre optics, it can be possible with FORS. With this technique the spectra obtained from that protective layer present a strong absorption band between 500 – 560 nm (centred at ca. 513 nm) and a shoulder between 400 – 500 nm, centred at ca. 450 nm and an inflection point at ca. 593 nm. According to Bisulca *et al.* (2008), it indicates the presence of a red lake. However, the grade of saturation of the material did not allow the identification of which colorant is exactly present [Bisulca *et al.* 2008] (***Figure 4.39***).

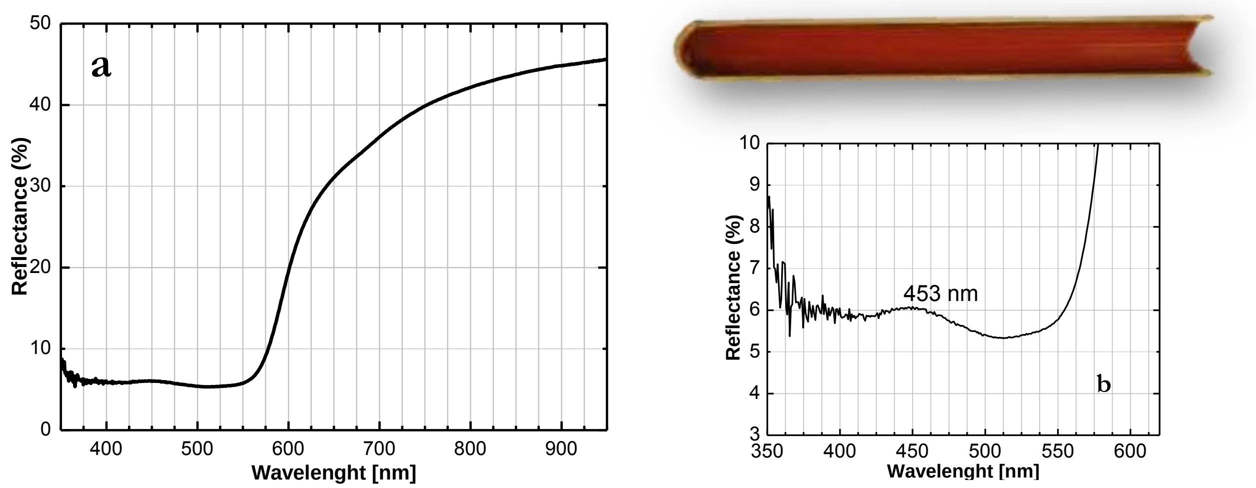


Figure 4.39. FORS results of the protective layer present on the head-edge of *La Légende de Saint Julien l'Hospitalier*: a) FORS main spectrum; b) Detail from FORS main spectrum.

4.6 Considerations on the pictorial palette identified

Tables 4.3 and 4.4 report the results of Amadeo's pictorial palette, identified during the study for the Catalogue *Raisonné* (2008) and that identified by Cristina Montagner (2015) in the last paintings of the artist from 1917, respectively.

Table 4.3. Amadeo de Souza-Cardoso's pictorial palette between 1913 and 1916 [Vilarigues *et al.* 2008, 91; Vilarigues *et al.* 2009].

1913-1916				
Cobalt blue	Viridian	Vermilion	Chrome yellow	Lead white
Prussian blue	Emerald green	Carmine	Cadmium yellow	Barium sulphate
Cerulean blue			Yellow ochre	
Ultramarine blue				

Table 4.4. Amadeo de Souza-Cardoso's pictorial palette in his paintings dated 1917 [Montagner 2015, 121].

1917					
Cobalt violet (arsenate)	Cobalt blue	Viridian	Vermilion	Chrome yellow	Lead white
Eosin based lake	Prussian blue	Emerald green	Carmine	Cadmium yellow	Zinc white
	Cerulean blue		ß-Naphthol red	Cobalt yellow	
	Ultramarine blue				

The analyses carried out in *La Légende de Saint Julien l'Hospitalier* (1912) pointed out that the pictorial palette used by the Portuguese painter in the end of his early career was composed by the pigments indicated in ***Table 4.5***.

Table 4.5. Pictorial palette of *La Légende de Saint Julien l'Hospitalier*.

1912						
	Cobalt blue*	Viridian‡	Vermilion‡	Cadmium orange‡		
Cobalt violet (arsenate)‡	Prussian blue	Emerald green	Carmine	Cadmium yellow‡	Gold	Carbon based pigment‡
	Ultramarine blue	Cobalt green*	Eosin Y dye‡	Yellow ochre‡	Silver	Foundation white§
				Burnt Sienna*		

* Pigment present only in the handwritten text; ‡Pigment present both in the illustration and in the handwritten text;
§ Pigment or dye present only in the book cover.

By comparison between the first two palettes presented, the results obtained from the pictorial materials used by Amadeo in the manuscript of Saint Julian reveal some common pigments in all three palettes: cobalt blue, considered Amadeo's blue in oil painting[266] was not very used in *La Légende* in the watercolour technique, since its application was only found in the handwritten text of p. 65. It seems that the artist found a chromatic equivalent in ultramarine blue in the watercolour technique, which is present in all three palettes. Prussian blue, viridian, emerald green, vermillion, carmine and cadmium yellow are also among the artist's colour preferences in all three periods. Chrome yellow, which is considered Amadeo's yellow colour[267], is absented from the palette used in *La Légende*, as well as Cerulean blue. Nevertheless, these two pigments were already commercially available for the manufacture of watercolours at the time[268]. Regarding earth pigments, yellow ochre finds affinity with the painter's palette used between 1913 and 1916. Concerning violet colours, cobalt violet in the arsenate type was one of Amadeo's preferences in *La Légende*, being also present in his last paintings, dated 1917. Eosin Y was identified in the ink used to write part of the text. An eosin-based lake has been detected in Amadeo's last paintings. The use of Foundation white (a mixture of zinc white with lead white) seems also

[266]Cf. Vilarigues *et al.* 2008, 84.
[267]Cf. Otero 2010, 1.
[268]Catalogue W&N 1896, xxxi.

to corroborate the white colours preferences of Amadeo in the last period of his career. Finally, the constant characteristic experimentalism of the artist is also noticeable in the introduction among his *handful of colours*[269] of different pigments already available before 1912 by colourmen[270]. In what concerns *La Légende de Saint Julien l'Hospitalier*, Amadeo also employed cadmium orange, the metallic colours gold and silver in the illustration and cobalt green and burnt sienna in the handwritten text that were not detected in his other artistic periods.

4.7 Colour mapping[271]

In this section, an essay establishes a connection with ***Chapter 2, section 2.3***, reflecting on the meaning of colours in *La Légende de Saint Julien l'Hospitalier.*

In medieval codices, colour acts as an aesthetic factor and was used to better highlight the text images. The colours in *La Légende* were applied pure in strong contrast of colours: blue-red, green-red and black-gold, taking after Gothic illuminations (***Figure 4.40***). Despite not possessing the opacity of the medieval tempera, colours in *La Légende* are very bright as in the Romanesque illuminations and the selected pigments are among the most enduring.

Figure 4.40. Examples of strong contrasts of colours in *La Légende de Saint Julien l'Hospitalier* (1912), p. 65, 77 and 137, respectively, MG-MC.

Recent studies on colour meaning in Portuguese medieval illuminations, revealed the importance of determining the proportion occupied in area by each colour [Melo and Miranda 2014; Melo *et al.* 2014; Castro *et al.* 2014; Miguélez Cavero *et al.* 2016]. Following the paradigm used in the referred study, it was carried out the colour mapping of *La Légende de Saint Julien l'Hospitalier* using mathematical

[269] Expression from Vilarigues *et al.* 2008.
[270] Cf. W&N 19th century recipes archive and Carlyle 2001.
[271] The experimental part of this work was performed in collaboration with Prof. João Lopes and Cristina Montagner in the framework of the *Crossing Borders* project.

algorithms [*see* ***Appendix A4.8***]. The aim of this study was to propose an interpretation for the relationship established between the chromatic richness of *La Légende* and the way how the artist communicated his perception of Flaubert's tale through his pictorial palette.

In the colour mapping study, both text and illustration colours were included (***Figure 4.41***). However, the black ink areas were not covered in this study, since they occupy 47% of *La Légende* coloured areas[272]. Note that the study also did not include the synopsis and the first pages of the manuscript.

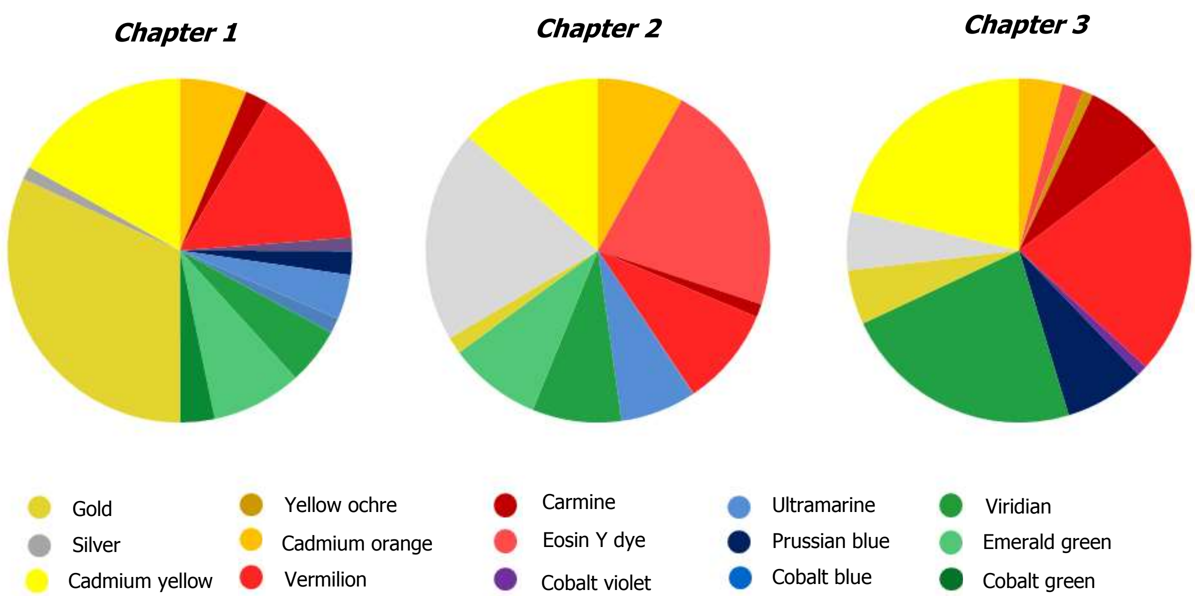


Figure 4.41. Results from colour mapping in *La Légende de Saint Julien l'Hospitalier*.

As referred in ***Chapter 1, section 1.2.1***, during Amadeo's early career, a new chromaticity rose with *La Légende*. As also pointed out in ***Chapter 2, section 2.3***, Souza-Cardoso's contrast of colours seems influenced by Robert Delaunay.

In October 1911, Delaunay began an active correspondence with the Russian artist Wassily Kandinsky (1866-1944) [Hughes 2014, 150]. The latter was very interest in the relationship between colour and music [Acton 2004, 220]. In a letter dated 1912, Delaunay wrote to Kandinsky about his discoveries in the application of colour: *I am still waiting until I can find greater flexibility in the laws I discovered. These are based on studies in the transparency of colour whose similarity to musical notes drove me to discover 'the movement of colours'* [Acton 2004, 220].

[272]Chapter I: Gold (34%), Silver (1%), Cadmium yellow (18%), Carmine (2%), Vermilion (16%), Cobalt violet (1%), Prussian blue (2%), Ultramarine blue (5%), Cobalt blue (2%); Viridian (6%); Emerald green (9%) and Cobalt green (4%). Chapter II: Silver (20%), Cadmium yellow (14%), Cadmium orange (8%), Eosin Y (22%), Carmine (1%), Vermilion (9%); Ultramarine blue (7%); Viridian (8%), Emerald green (9%) and Gold (2%). Chapter III: Silver (6%), Cadmium yellow (21%), Cadmium orange (4%), Eosin Y (2%), Yellow ochre (1%), Carmine (8%), Vermilion (22%), Cobalt violet (1%), Prussian blue (7%), Viridian (23%) and Gold (5%).

In 1911, Kandinsky published the essay *Concerning the Spiritual in Art*, where he examined the physiological effect of colours[273]. It is not known if Souza-Cardoso knew this text. Eventually, it occurred through Sonia Delaunay[274]. Nevertheless, in *La Légende*, Amadeo seems to have established a dialogue between his colours and their meaning as described by Kandinsky.

In this section, it will be depicted some of these evidences that also express Amadeo's ideas regarding the rule of emotion in his artistic creation.

In the following excerpt from *Concerning the Spiritual in Art*, Kandinsky presents the impression that colour can offer in the perception of an artwork:

> *To let the eye stray over a palette, splashed with many colours, produces a dual result. In the first place one receives a purely physical impression, one of pleasure and contentment at the varied and beautiful colours. The eye is warmed or else soothed and cooled. But these physical sensations can only be of short duration. They are merely superficial and leave no lasting impression, for the soul is unaffected* [Kandinsky 2002, 57]. *(…) But to a more sensitive soul the effect of colours is deeper and intensely moving. And so we come to the second main result of looking at colours: their psychic effect. They produce a corresponding spiritual vibration, and it is only as a step towards this spiritual vibration that the elementary physical impression is of importance. (…) The eye is strongly attracted by light, clear colours, and still more strongly attracted by those colours which are warm as well as clear*[275] [Kandinsky 2002, 58].

The obtained results from the colour mapping study show a chromatic evolution along the three chapters of the manuscript. This fact finds a parallelism with the sequence of the story of Saint Julian the Hospitaller. Thus, in Chapter I that refers to Julien's "golden years", Amadeo de Souza-Cardoso profusely used gold (34%) instead of silver (1%). In Chapter II, where Julien runs away home and commits the parricide, the golden tones were reduced (2%) giving place to silver (20%). This colour substitution gives a sense of cold and discomfort. Finally, in Chapter III where is narrated Julien's life as penitent and future saint, gold (5%) and silver (6%) are present in similar proportions. The work ends with the representation of Saint Julian in his boat, where moon and halo of holiness melt in the same large silver area.

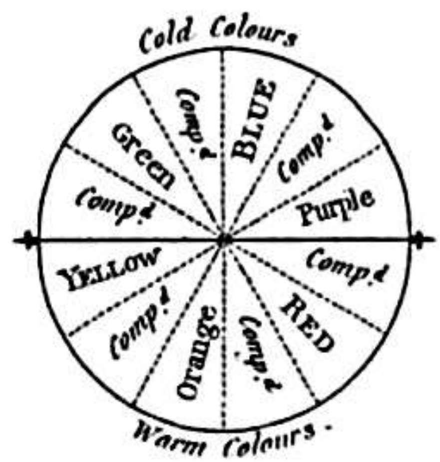


Figure 4.42. Charles Hayter's warm and cold "painter's compass" from his *Introduction to Perspective* (1813) [Gage 1999, 23].

[273]No data was found that confirms that Souza-Cardoso met Kandinsky [Cf. Oliveira 2006].
[274]In 1911-1912, Sonia Delaunay translated Kandinsky's essay *Concerning the Spiritual in Art* [Slevin 2015, 119]. Amadeo was in close contact with the Delaunay couple in that same period as already referred in *Chapter 1* and maybe had access to this book through Sonia Delaunay.
[275]Translation by the author of this dissertation.

From this analysis it is possible to observe that, according to the identified pigments, there is a predominance of red, orange and yellow, i.e. of warm colours[276]. Kandinsky quoted Eugène Delacroix (1798-1863) who stated, *everyone knows that yellow, orange and red suggest ideas of joy and plenty*[277]. By their turn, cold colours – green, blue and violet (or purple) were less used in *La Légende* and their proportion stills almost constant in all three chapters (***Figure 4.42***).

Red colours are the most used by Souza-Cardoso in the manuscript. In the following lines, Kandinsky reports the effect of this colour:

> *(…) Red may cause a sensation analogous to that caused by flame, because red is the colour of flame. A warm red will prove exciting; another shade of red will cause pain or disgust through association with running blood. In these cases colour awakens a corresponding physical sensation, which undoubtedly works upon the soul* [278] [Kandinsky 2002, 58].

In fact, the use of vermilion and the eosin Y dye as warm red communicates Julien's glaring temperament along the text. In Chapter III, the Portuguese painter applied more carmine in the illustration. This dark red (or *bordeaux*) provides a certain atmosphere of pain associated to Julien's conversion. This fact is observable in the page of the manuscript that narrates the meeting between Julien and the Leper (p.134) and in the last page of the tale, when Julien reaches holiness (p.136) (***Figure 4.43***). Note that in the latter, Julien is represented as saint and dressed in red.

Figure 4.43. Examples of the application of red and *bordeaux* colours in *La Légende de Saint Julien l'Hospitalier* (1912), p. 134 and 136, respectively, MG-MC.

Cadmium yellow is present in almost the same proportion in all three chapters. Kandinsky mentioned yellow colours in the following way:

Figure 4.44. Examples of the application of yellow colours in *La Légende* (1912), p. 62 and 132, respectively, MG-MC.

[276]Charles Hayter (1761-1835) was probably the first systematic theorist to introduce the notion of warm-cold coordinates [Gage 1999, 23].

[277]Cf. Kandinsky 2002, 63.

[278]Translation by the author of this dissertation.

Yellow is the typically earthly colour. It can never have profound meaning. (…) It may be paralleled in human nature, with madness, not with melancholy or 'hypochondriac' mania, but rather with violent raving lunacy[279] [Kandinsky 2002, 81].

In fact, this colour was used by Amadeo to express, with red, the "drunkenness" of the *damned hunter*[280] (p. 62) and the blind bravery of the *Hospitaller* (p. 132) (***Figure 4.44***).

In what regards the blues, Wassily Kandinsky pointed out that *blue is the typical heavenly colour. (…) The ultimate feeling it creates is one of rest*. *When it sinks almost to black, it echoes a grief that is hardly human*[281] [Kandinsky 2002, 82]. As a matter of fact, the very dark Prussian blue was the single blue colour used in *La Légende* in the illustrations of Chapter III and can be related with the serenity and certain melancholy during Julien's conversion process. Kandinsky also referred about the meaning of colours writing: *Many colours have been described as rough or sticky, others as smooth and uniform, so that one feels inclined to stroke them*[282] and pointed out ultramarine blue as one of such colours [Kandinsky 2002, 59]. Amadeo applied that colour only in Chapters I and II, which seems to communicate to the illustration the vibrancy of Julien's metamorphosis (***Figure 4.45***).

Figure 4.45. Examples of the application of blue colours in *La Légende de Saint Julien l'Hospitalier* (1912), p. 82 (ultramarine blue) and 124 (Prussian blue), respectively, MG-MC.

Concerning the greens, Kandinsky explains the character of such colour:

Green is the most restful colour that exists. On exhausted men this restfulness has a beneficial effect, but after a time it becomes wearisome. Pictures painted in shades of green are passive and tend to be wearisome; this contrasts with the active warmth of yellow or the active coolness of blue. In the hierarchy of colours green is the "bourgeoisie" – self-satisfied, immovable, narrow. It is the colour of summer, the period when nature is resting from the storms of winter and the productive energy of spring[283] [Kandinsky 2002, 83].

The proportion of greens in *La Légende* is almost the same in all three chapters which seem to create a certain balance with the warm colours, pacifying the emotions of the reader when facing with Julien's temper. This effect is also reflected in the representation of nature elements with this colour (***Figure 4.46***).

[279]Translation by the author of this dissertation.
[280]Cf. *Chapter 2, section 2.1.2.*
[281]Translation by the author of this dissertation.
[282]*Idem.*
[283]*Idem.*

Kandinsky also observed that cobalt green seem to be a dry colour [Kandinsky 2002, 59]. This pigment is present in the text of pages that narrate Julien's cruelty with animals. Moreover, the artist referred that:

Any preponderance in green or yellow or blue introduces a corresponding activity and changes the inner appeal. The green keeps its characteristic equanimity and restfulness, the former increasing with the inclination to lightness, the latter with the inclination to depth [Kandinsky 2002, 84].

In Chapter I and II, a balance between the use of emerald green and viridian is observed. The former provides energy and the latter, by its turn, expresses gravity to the illustration. Actually, viridian is the single green colour used by Souza-Cardoso in the last chapter of *La Légende*.

Figure 4.46. Examples of the application of green colours in *La Légende de Saint Julien l'Hospitalier* (1912), p. 74 (cobalt green), 101 (emerald green) and 128 (viridian), respectively, MG-MC.

Finally, in what regards orange and violet colours, Kandinsky brought up:

Warm red, intensified by a suitable yellow, is orange. This blend brings red almost to the point of spreading out towards the spectator. But the element of red is always sufficiently strong to keep the colour from flippancy. Orange is like a man, convinced of his own powers. (…) Just as orange is red brought nearer to humanity by yellow, so violet is red withdrawn from humanity by blue. But the red in violet must be cold, for the spiritual need does not allow of a mixture of warm red with cold blue. Violet is therefore both in the physical and spiritual sense a cooled red. It is consequently rather sad and ailing[284] [Kandinsky 2002, 89].

Figure 4.47. Examples of the application of orange colour in *La Légende de Saint Julien l'Hospitalier* (1912):p. 2 and 117, MG-MC.

[284]Translation by the author of this dissertation.

Cadmium orange is present in almost the same proportion in the three chapters of Amadeo's manuscript (***Figure 4.47***). Its presence is mainly related to the episode of the parricide and sustains the idea of the force of such abominable act. Nevertheless, at the same time, orange is a less ferocious colour than red. The choice of this colour for the illustration of the letters of the book title (p.2) seems to communicate that malevolence was won by holiness.

By its turn, cobalt violet which is only present a few times in *La Légende* transmits a sense of sadness associated to the content of the tale (***Figure 4.48***).

Figure 4.48. Examples of the application of violet colour in *La Légende de Saint Julien l'Hospitalier* (1912): p.87 and 105 (cobalt violet), MG-MC.

Figure 4.49. *La Légende de Saint Julien l'Hospitalier* (1912): p.123, MG-MC.

Lastly, the first page of Chapter III (p.123) presents almost all colours previously discussed and seems to sum up all the emotions in Julien's spirit in the beginning of his conversion process. Some of them are contrasting: ferocity and violence against himself, pain, strength, sadness, serenity and gravity (***Figure 4.49***).

The quantification of colour through colour mapping provided an understanding of the distribution of colour along the illustration of the tale. Moreover, *La Légende de Saint Julien l'Hospitalier* seems to corroborate Wassily Kandinsky's idea that *balance and proportion cannot be found outside of the artist but within him*[285].

In *La Légende*, Amadeo testimonies his admiration for the masters of light and colour: the medieval copyist monks. It is also an affirmation of his artistic personality and modernity as discussed in ***Chapter 2***. Using colours to give expression to Flaubert's words, the Portuguese artist emphasised details that, consciously or unconsciously, create dynamism throughout this artist's book, generating emotions in the reader.

[285] Cf. Kandinsky 2002. Translation by the author of this dissertation.

4.8 Preventive conservation guidelines

Materials' ageing is a spontaneous phenomenon that is irreversible and cannot be stopped. However, in what regards the Cultural Heritage field it is necessary to implement adequate strategies to protect objects and artefacts, aimed at reducing deterioration rates and minimizing risks to collections from the action of several agents[286] [Michalski 1992; Merrit and Reilly 2010, 11; Pretzel 2011]. Preventive conservation deals with these issues and reduces the need for curative interventions.

At the end of the study of the materials and techniques of *La Légende*, it is pertinent to establish preventive care guidelines for this singular artist's book. These guidelines will deal with environmental risk factors: relative humidity (RH), temperature (T), pollutants and light which should be monitored at the storage and exhibition room. Note that, since this manuscript is a composite of different materials – paper, parchment, watercolours and adhesives, each one with specific conservation requirements, it is necessary to find a compromise solution for its conservation. Parchment requires a stable point between 45-60% RH [Woods 2006, 209]. Since works on paper should be preserved around 50% RH, this value is recommended for the conservation of the manuscript as well as for the stabilisation of all materials present in the manuscript [Michalski 2000, 1]. However, this value may promote the mechanisms of silver degradation [*see* ***Appendix A4.6***]. Note that fluctuations of T and RH may cause deformation in the organic materials due to humidity and may promote discoloration of pigments [Casanovas 2008, 91]. In *La Legende*'s case, the recommended environment T is 20 ± 2ºC [Michalski 2000, 1].

In what concerns illumination, minimal exposure to all kinds of light is recommended since direct or intense light may aggravate the yellowing and brittleness of the different papers present and fading of the pigments and inks. During the exhibitions, the adequate illumination should be minimal in time and intensity, in order to allow the visitor to observe the artwork but avoiding the promotion of its deterioration [Shaw 1996, Michalski 1997, Ashley-Smith 2013]. Nevertheless, the pages where carmine and the eosin Y ink are present [*see Résumé* of results in ***Appendix A4.4***], should not be selected for display since these colourants are very sensible to light exposure [Saunders and Kirby 1994; Zuixiong 2004, 53; Eastaugh *et al.* 2008, 157; Claro *et al.* 2010; Greeneltch *et al.* 2012].

The storage room of MG-MC where *La Légende* is kept has thick material walls and appropriate isolation which endorses an adequate thermic and hygroscopic inertia.

The most adequate housing for *La Légende* should be a box constructed according to the design presented in ***Appendix A4.9***, to reduce handling. This box will both provide an excellent protection for the book and facilitate the handling movements with both hands to pick up the book. The recommended box material is *acid-free* paper with alkaline buffer in order to neutralise acids. As previously referred in ***Chapter 3***, the manuscript has acidified endpaper, fly-leaves and guards. Over time, these elements

[286]The ten agents of deterioration are: physical forces, thieves and vandals, fire, water, pests, pollutants, light, UV and IR, incorrect temperature, incorrect relative humidity and dissociation
[Source: AIC website: http://www.conservation-wiki.com/wiki/Ten_Agents_of_Deterioration. Last accessed on February 11, 2017].

would become darker, even more acidified and brittle. Since the manuscript contains silver, the decrease of pH with time could promote the formation of degradation products in silver painted areas as foreseen in the respective Pourbaix diagram [*see* ***Appendix A4.10***]. To overcome the problem with localized acidification on the endleaves, it is suggested to insert sheets of buffered paper between the endpaper and fly-leaves to work as barrier sheets or *interleaving*. It is recommended a slightly heavier-weight bond paper less likely to wrinkle and to not cause damage on the spine of *La Légende*[287]. For example, a buffered paper 80g/m^2 with pH 7.5-10 is adequate for this purpose. The paper should be 100% cotton fibre from pure cotton linters and should pass the silver tarnishing test. Scavengers are common methods of removing or reducing chemical pollutants used in museums [Shashoua 1999, 94]. Once every six months, the pH and the colorimetric coordinates of the endleaves should be monitored. In *La Légende*'s case, activated charcoal may be utilised for this purpose. It is available as powder, cloth, boards and paper and is able to remove a wide range of pollutants and water vapour [Shashoua 1999, 94]. The cloth form could be used to wrap the manuscript. This procedure may promote the stabilisation of silver oxidation observed in some pages. ***Figure 4.50*** summarises these recommended procedures for preventive conservation of *La Légende*. This storage solution is the best compromise solution for this case study and should be accompanied by continuous monitoring of pollutants[288] and fluctuations of T and RH[289] in order to allow a correct intervention in case of harmful variations in the artwork.

Figure 4.50. Scheme of some of the recommended preventive conservation procedures for *La Légende*.

Monitoring the museum's environment is a foundational element of an overall preservation program. It is also preferable to handle the manuscript wearing white cotton gloves to provide a safe and soft barrier between dirt and oily hands. In this way, it will be possible to retard the degradation of *La Légende* allowing the future generations to enjoy Amadeo's manuscript, unique in the panorama of the Portuguese and international Art History.

[287]Cf. Balloffet *et al.* 2005, 70.
[288]Paula Menino-Homem refers that some tests allow the identification of these pollutants. Chlorine can be detected by Beilstein test. Sulphur is detected with the lead acetate test [Menino-Homem 2013].
[289]T and RH can be controlled with appropriate dataloggers. RH can also be monitored using humidity cards. Colour change from brown to green (cobalt-free cards) help to control moisture.

4.9 Conclusion

FORS, μ-Raman and μ-EDXRF *in situ* analyses were utilised in the study of the materials and techniques used by Amadeo de Souza-Cardoso in the copy and illustration of Gustave Flaubert's *La Légende de Saint Julien l'Hospitalier*. In the pages selected for analysis, it was observed that the artist used, in general, pure colours without mixtures. From the three analytical techniques employed in the study, Raman microscopy was found to be the most successful in the identification of the pigments used by the artist. As a matter of fact, the pigments identified by Raman include, in the manuscript's illustrations, cobalt violet (arsenate type), Prussian blue, ultramarine blue, viridian, emerald green, yellow ochre, cadmium yellow and orange, vermilion, a carbon-based pigment, silver and cobalt blue and eosin Y in the handwritten text. Moreover, results obtained with μ-Raman, does not indicate the presence of a white pigment mixed to the watercolours and, therefore the body-colour painted areas referred in ***Chapter 3*** do not seem to correspond to the gouache technique. The main limitations concerning the use of Raman technique in the analysis of this case study concerned the identification of the binding media due to strong fluorescence and the identification of the lake present in the *bordeaux* coloured areas of the manuscript. FORS also presented efficiency in the identification of Amadeo's pictorial palette in *La Légende*, revealing limitations in the identification of the inorganic red pigment, since vermilion and cadmium red present similar reflectance spectra. The joint use of μ-EDXRF was determinant for the confirmation and/or complementation of the obtained results with FORS and μ-Raman. For instance, μ-EDXRF allowed to determine the presence of the arsenate type in the cobalt violet colour and the presence of mercury as adulterant of carmine. This multi-analytical approach allowed a complete determination of Amadeo de Souza-Cardoso's pictorial palette at the end of his early career, being composed by: cobalt violet (arsenate), cobalt blue, Prussian blue, ultramarine blue, viridian, emerald green, cobalt green, cadmium orange, cadmium yellow, yellow ochre, burnt sienna, vermilion, carmine, eosin Y dye, gold, silver, a carbon-based pigment and Foundation white. Interestingly, chrome yellow, considered Amadeo's yellow is absent in his use in *La Légende* as well as cerulean blue. Eventually, the artist decided to start using them only in the following artistic period. Cobalt blue established also as the artist's blue in oil painting, was only used in the text of a single page of the manuscript. It seems that Souza-Cardoso found in ultramarine blue a chromatic substitute of cobalt blue in watercolours.

By comparison with the palette used by the artist between 1913 and 1916 and in his last oil paintings dated c.1917, it was possible to observe that the common pigments to all three Amadeo's palettes are: cobalt blue, Prussian blue, ultramarine blue, viridian, emerald green, carmine and cadmium yellow. In common with the palette used by the artist between 1913 and 1916 it was found the use of yellow ochre. Finally, with colour preferences in his last paintings, it was found affinity with the presence of cobalt violet (arsenate), eosin Y and Foundation white. In all three palettes were found uncommon pigments, result of the artist's experimentalist character. In *La Légende*, in addition were found gold, silver, cadmium orange and burnt sienna.

In the identification of the binding medium present in Amadeo's bright colours, μ-Raman showed a strong fluorescence. Moreover, due to the strong signal of paper in the NIR region and due to restricted range of analysis of the FORS device used, it was not possible to identify the binding medium present in the artist's colours in *La Légende*. Nevertheless, through a statistical approach from FORS spectra, "tentatively" suggests Arabic gum as binding medium.

FORS analysis also proposes cobalt violet as the pigment present in the page numbering of the manuscript. Moreover, the technique was also suitable to the identification of parchment as the cover material of the book. On it, the remains of three small coats of arms were painted with emerald green, ultramarine blue, vermilion and Foundation white having been identified with the three techniques. The reduced working range of the FORS equipment used in this study, did not allow the identification of the binding medium present in the coats of arms. The identification of parchment as cover material also contributed to the establishment of bridges between *La Légende de Saint Julien* and medieval manuscripts since the use of such material for this purpose was not so common in the early 20th century.

In comparison with μ-Raman and μ-EDXRF, FORS does not observe the same transportation difficulties. Moreover, its portable and small device allows an easy application in the museum environment, allowing the obtainment of results quickly and in few seconds and the ability to analyse the acquired spectra in real time. These reasons conducted to the possibility to acquire more data respect to the other techniques employed. The system of fibre optics also made possible the analyses aiming the identification of the colourant present in the head edge of the book, since this is a less accessible area of analysis to the most of the analytical techniques. Due to the saturation of the referred colourant, FORS was only able to identify it as a red lake.

Having as starting point the identified pictorial palette of *La Légende*, it was possible through colour mapping, to understand the chromatic richness present in this manuscript, following the paradigm used at DCR-FCT-UNL, in the studies of medieval illuminations. In fact, Amadeo de Souza-Cardoso used strong contrast of colours that can be found in Gothic illuminations and very bright as in the Romanesque ones. Beyond being the unifying element of Amadeo's work, as discussed in ***Chapter 2***, colour was applied from the artist's emotional experience that creates dynamism along Flaubert's tale and provoking emotions in the reader.

Finally, the study of the materials and techniques of *La Légende de Saint Julien l'Hospitalier* allowed the establishment of adequate preventive conservation guidelines for the museum where this artwork is presently kept in custody.

❸

LIBRARY OF UV-VIS-NIR REFLECTANCE SPECTRA OF MODERN WATERCOLOUR PAINTS

Then God said: 'Let there be light', and there was light.

(Gn. 1, 3)

CHAPTER 5: Introduction to UV-Vis-NIR Fibre Optic Reflectance Spectroscopy

5.1 Preamble

The main purpose while studying art objects is to extract as much as possible information, always minimising the risk of damage.

In the last decades, numerous efforts have been undertaken aiming to develop *in situ* (or generally called *non-invasive*) analytical tools. These techniques can provide the chemical description of the area under study without any contact with the object [Bacci *et al.* 2009b, 197; Miliani *et al.* 2010]. Portable or transportable devices make possible to perform measurements on-site [Bacci *et al.* 2009b, 199].

Figure 5.1. Analyses with FORS on a set of frescos during the mission performed at the Brancacci Chapel (1983), IFAC-CNR.

Fibre Optic Reflectance Spectroscopy (FORS) is among the *in situ* analytical techniques and has been applied in the Conservation field since late 1970s. The technique was employed for the first time by the National Gallery of London to monitor light-induced colour changes in paintings [Bullock *et al.* 1978; Bacci and Cappellini 1987; Bacci *et al.* 1991]. It is considered as a variant of laboratory UV-Vis-NIR spectrophotometry in diffuse reflectance mode (DRS) [Aceto *et al.* 2014]. Years later, FORS was also used at the Victoria and Albert Museum [Martin and Pretzel 1991].

The *Istituto di Fisica Applicata 'Nello Carrara'* (IFAC-CNR)[290] is among the pioneers in the application of FORS in studies concerning art conservation practices in works of art. The first mission carried out by this institute occurred in 1983 and regarded the analysis of a set of frescoes by Masaccio, Masolino and Fillipino Lippi at the Brancacci Chapel in the Church of Santa Maria del Carmine in Florence (***Figure 5.1***).

[290]Until 2002, this institution was named *Istituto di Ricerca sulle Onde Elettromagnetiche* (IROE-CNR).

By means of an external integrating sphere which was connected through optical fibres to a UV-Vis spectrophotometer[291], several reflectance spectra were collected before and after restoration. The results were compared with those performed in a set of small mock-ups of frescos of pure pigments, prepared in laboratory. Those results contributed to the starting point of the creation of a suitable database for the identification of pigments, to the evaluation of colour and colour changes and to provide useful information to conservators and art historians [Bacci *et al.* 1991].

FORS is a general accepted technique in the Conservation field. The devices became more sophisticated in the course of the years and have been applied as powerful *in situ* tool for the characterisation of colour materials (pigments and dyes) in diverse research areas, such as easel painting [Bacci *et al.* 2005; Bacci *et al.* 2007; Bacci *et al*. 2009], painting on paper [Leona and Winter 2001], mural painting [Appolonia *et al.* 2009; Garofano *et al.* 2016], ancient stained glass windows [Bacci *et al.* 2007b; Vilarigues *et al.* 2015], textiles [Cazenobe *et al.* 2002; Gulmini *et al.* 2016], ancient illuminated manuscripts [Picollo *et al.* 2011; Doherty *et al.* 2013; Melo *et al.* 2014b; Delaney *et al.* 2014; Aceto *et al.* 2017], graphic documents [Montagner *et al.* 2011], modern and contemporary art [Carlesi *et al.* 2013; Cucci *et al.* 2013; Bartolozzi *et al.* 2015; Cucci *et al.* 2016].

Among its advantages, FORS allows recording a large amount of spectroscopic data without micro--sampling, in accordance with the principle of minimum intervention [Bacci *et al.* 2005]. This fact makes possible to monitor the state of conservation since the technique allows the acquisition of precise spectral information on single points [Casini *et al.* 2005]. Other advantages of FORS, as discussed in ***Chapter 4***, include the low weight and the portability of the instrument, which allows measurements in the place where the artwork is housed, the quickness of spectra acquisition (ca. 2 seconds) and the ability to analyse spectra practically in real time [Bacci *et al*. 2009b, 199; Aceto *et al.* 2014]. This fact is crucial not only in terms of productivity in research activity but also in the issues regarding the time of radiation exposition during the analysis. In the case of FORS measurements this exposition is minimal, which reduces eventual physical or chemical alterations in the surface under study [Aceto *et al.* 2014]. Moreover, choosing adequate probe geometry, FORS provides analyses of very small areas of the artwork [Bacci *et al*. 2009b, 198].

Concerning the technique drawbacks, in some cases, the identification of some pigments is not totally unequivocal. For instance, FORS does not allow the distinction between vermilion and cadmium red. The technique has lower *fingerprinting* when compared, for instance with Raman spectroscopy, as already seen in ***Chapter 4***, or Fourier transform infrared spectroscopy (FTIR) [Aceto *et al.* 2014]. Moreover, this methodology is also not clear in the identification of mixtures of pigments [Bacci *et al.* 2009, 199; Aceto *et al.* 2014].

[291]The spectrophotometer used was Perkin-Elmer (model 552).

In the following section, it will be briefly described the phenomena connected with the interaction between light and matter. A particular focus will be given to the interaction UV-Vis-NIR radiation-paint layer. An overview of UV-Vis-NIR Diffuse Reflectance methodologies – FORS and DRS – will be also presented.

5.2 Within the Light: UV-Vis-NIR Spectroscopy

As known, Spectroscopy is a field of Optics that measures and interprets the interaction between light and matter [Ramanathan 2005, 259]. *Light* -electromagnetic radiation- is here assumed as the continuous energy called electromagnetic spectrum [Derrick *et al.* 1999, 4]. In this dissertation, attention will be given in more detail to the UV, Vis and IR range of energies.

Electromagnetic (e.m.) radiation is considered to have double nature: wave and corpuscle (or particle). In what concerns the former, all energies of the electromagnetic spectrum can be considered as waves which are longitudinal and travel at the constant *velocity* value (c) ca. 3×10^8 $m \cdot s^{-1}$ in vacuum. According to the demonstration of Maxwell's electromagnetic wave theory in 1864, e.m. radiation (also called electromagnetic waves) is a combination of an oscillating electric field and, perpendicular to it, an oscillating magnetic field. Their wavelengths are identical, and the crests and valleys occur at exactly the same places along the direction of travel of the wave (***Figure 5.2***) [Brill 1980, 2; Aldrovandi and Picollo 2007, 9].

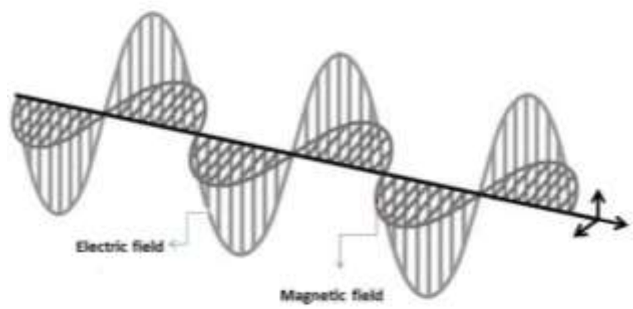


Figure 5.2. Oscillating electric and magnetic fields in electromagnetic waves.

In the electromagnetic wave theory, some parameters can be defined in the following way: *frequency* (ν) is the number of oscillations or waves per second [Hertz (Hz)]; *period* (T) is the duration of a oscillation and it is the inverse of frequency ($T=1/\nu$) [second (s)] and *wavelength* (λ) is the distance between two successive maxima or minimum of the wave [meter (m)]. Note that commonly in the UV, Vis and NIR regions the wavelength is measured in nanometers [Brill 1980, 3; Derrick *et al.* 1999, 5; Aldrovandi and Picollo 2007, 9].

The velocity of propagation of a monochromatic wave (c) (single frequency) is given by the following formula:

$$c = \lambda \cdot \nu \tag{5.1}$$

It means that the wavelength of the e.m. radiation is inversely proportional to frequency. So, high-frequency radiation has short wavelengths [Brill 1980, 2; Derrick *et al.* 1999, 5].

When light is seen as a stream of *discrete particles of energy* called quanta or photons, according to Planck's relation (2), *energy* (E) is directly proportional to frequency:

$$E=h\cdot\nu \quad (5.2)$$

Where h is Planck's constant ($6.626x10^{-34}$ J·s). So, the energy of the e.m. radiation is inversely related with wavelength [Brill 1980, 4; Derrick *et al.* 1999, 5].

Spectroscopy is based on the Bohr-Einstein frequency relationship [Perkampus 1992, 1]:

$$\Delta E= E_{final\ state}-E_{final\ state} \quad (5.3)$$

This means that absorbed or emitted radiation of a certain frequency ν can be assigned to specific energy-level differences [Perkampus 1992, 1]. This issue will be further discussed in ***section 5.2.1***.

As shown in ***Figure 5.3***, in what concerns the range UV-Vis-IR of the e.m. spectrum, UV rays have highest frequencies and lower wavelengths. By its turn, IR rays have lower frequencies. Wavelength of e.m. radiation is inversely related with energy.

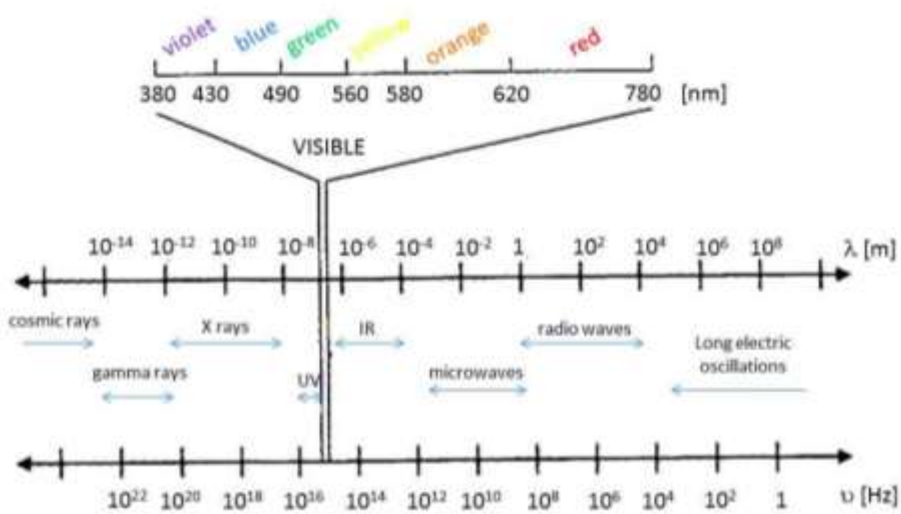


Figure 5.3. The e.m. spectrum (According to Aldrovandi and Picollo 2007, 10).

UV radiation was discovered in 1801 by the German chemist Johann Wilhelm Ritter by observing that silver chloride is sensitive to radiations at wavelengths shorter than violet [Brill 1980, 10; Bacci 2000, 321; Orna 2013, 16].

In the electromagnetic spectrum, the UV region (10-380nm) is subdivided into four spectral regions. The range between 10 and 180 nm is referred as vacuum ultraviolet. The 180-280 nm range is called the short or far-ultraviolet. The 280-300 nm wavelengths correspond to the mid-ultraviolet. Finally, the 300-380 nm range is mentioned the long or near-ultraviolet [Rao 1975, 1; Brill 1980, 10]. Note that radiation in the 200-380 nm causes photochemical reactions and bond rupture in many organic compounds due to the high energy radiation. However, in the Conservation field, UV light is used for example, in the observation of *foxing*[292], one of the signs of paper deterioration [Brill 1980, 10].

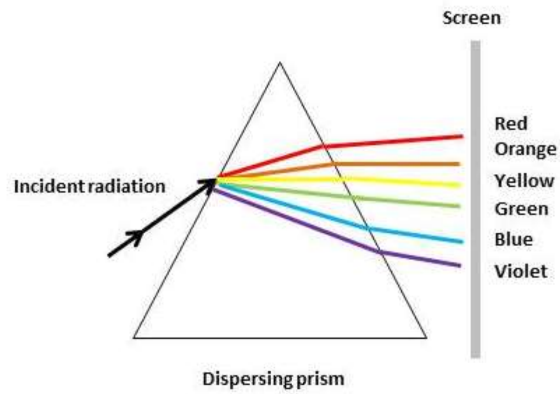


Figure 5.4. Schematic diagram of Newton's prismatic dispersion experiment (According to Orna 2013, 13).

The visible region corresponds to the range of wavelengths between 380 and 780 nm. The response of the human eye (retina) and brain to the interaction with this radiation results in a visual stimulus called *colour* [Rao 1975, 1; Brill 1980, 11].

In 1672, Sir Isaac Newton (1643-1727), English mathematician and astronomer performed experiments with sunlight and a triangular glass prism. He observed a rainbow of colours dispersed by the prism ranging from violet to deep red, which could be observed on the wall of a darkened room. Newton gave to the result the name *spectrum* (***Figure 5.4***) [Brill 1980, 11; Bacci 2000, 321; Ball 2012; Orna 2013, 12].

In the visible region, each colour is associated with a range of frequencies and wavelengths (***Table 5.1***). These six ranges are called pure spectral colours [Orna 2013, 15].

Table 5.1. Approximate wavelength for the different colours.

Violet	Blue	Green	Yellow	Orange	Red
380-430 nm	430-490 nm	490-560 nm	560-580 nm	580-620 nm	620-780 nm

Photochemical reactions may also occur due to the interaction of visible light [Brill 1980, 12].

In 1800, Sir Frederick William Herschel (1738-1822), a German musician and astronomer, accidently discovered infrared rays. Herschel used a prism as well and obtained the decomposition of the various colour from blue to red. Using a mercury thermometer, he decided to measure the different temperatures throughout the visible spectrum. Herschel noted that the maximum value of temperature occurred beyond the red band where light cannot be seen [Maldague 1993, 1; Bacci 2000, 321].

[292] *Foxing* regards the brown spots sometimes observed due to the bacteria's action or the acidity of paper or even due to the presence of metallic particles from the paper manufacture.

IR region lies between the extreme end of the visible spectrum (about 0.78 μm) and the shortest microwaves (about 1000 μm). It can be subdivided into three spectral regions: the near-infrared (NIR) about 0.78 μm to 3 μm (780-3000 nm), the mid-infrared, about 3 μm to 30 μm (3000-30000 nm) and the far infrared, about 30 μm to 1000 μm (30000 nm-1 mm) [Weik 1997, 458; Derrick *et al.* 1999, 13; Orna 2013, 16].

In UV-Vis-NIR range, each region is defined by intrinsic properties and characteristics. Actually, they can produce on matter specific chemical and physical effects [Brill 1980, 2; Derrick *et al.* 1999, 4]. UV and Vis occupy a very narrow frequency region. Nevertheless, their energy differences correspond to those of *electronic states* of atoms and molecules. For this reason, UV-Vis spectroscopy is also denominated *electronic spectroscopy* [Perkampus 1992, 1]. IR radiation causes changes in the vibrational energy of molecules [Rao 1975, 1; Derrick *et al.* 1999, 4]. In particular, NIR spectroscopy allows the study of low-energy electronic transitions and overtones and combinations of stretching and bending vibrational modes of O–H, N–H or C–H groups. It is also used for the characterisation of transition metal ions, as will be seen in ***Section 5.3*** of this chapter [Derrick *et al.* 1999, 13]. Analysis in the NIR range also provides the possibility of identification of the binding media [Miliani *et al.* 2010, Ricciardi *et al.* 2012, Dooley *et al.* 2013], materials from the preparatory layer (e.g. gypsum) and alteration products (e.g. calcium oxalates) [Bacci *et al.* 2005; Bacci *et al.* 2009b, 199]. Note that cobalt based pigments also show absorption bands in the NIR region due to electronic transitions [Bacci *et al.* 2009].

5.2.1 Interaction of e.m. radiation with matter

In describing e.m. radiation and its interaction with matter, a number of physical phenomena can occur with an optic medium – solid, liquid or gas [Nassau 1997, 10]. ***Figure 5.5*** illustrates in a simplified way the possible interactions between radiation-matter in a block of a semi-transparent material.

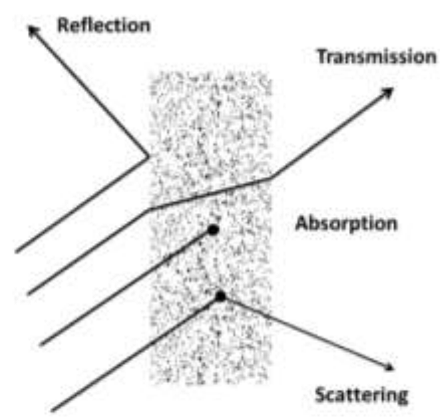


Figure 5.5. Possible interactions between radiation-matter in a block of a semi-transparent material.

In the context of this dissertation, some of these phenomena will be discussed. In the following paragraphs some theoretical information concerning: (a) *Absorption* and *Transmission*, (b) *Reflection* (specular or diffuse) and *Refraction* will be presented. It is worth to refer that the way how the human eye perceive colour is intrinsically connected with these phenomena. This means some of the wavelengths of white light emitted by a source interact with matter, and so the light that emerges is no longer white. The colour observed is complementary to that which is absorbed. The complementary colour is generated from the wavelengths left over (e.g. green light absorbed by matter is perceived as red) (***Table 5.2***) [Nassau 1997, 125; Janes and Moore 2004, 14].

Table 5.2. The relationship between absorbed and reflected (perceived) colour [Choudhury 2014, 86].

Perceived colour of compound	Colour absorbed by compound	Wavelenght of absorbed light [nm]
Blue	Red	600-700
Cyan	Orange	560-700
Magenta	Green	480-520
Red	Bluish green	400-620
Orange	Greenish blue	460-500
Greenish-yellow	Violet	400-440
Yellow	Blue	400-500

a) Absorption and Transmission

When a beam of radiation is propagated in a material medium, its intensity gradually decreases throughout its progress through the medium due to absorption [Heath 1989, 6; Choudhury 2014, 64]. In almost all conventional dyes or pigments, light is absorbed in certain wavelengths (absorption band) [Choudhury 2014, 64]. These bands are characteristic of the molecule. Light absorbed is lost and converted to heat or other forms of energy depending on the physical nature of the material (e.g. emission processes as fluorescence, when decay time constant is about 10^{-9}-10^{-5} s and phosphorescence, if the time constant is from about 10^{-3} s). In atoms and molecules, electrons are excited into a higher energy level arrangement within the molecule structure. Then, it occurs the electrons quick fall back to their original stable state. The correspondent absorption band concerns to the amount of energy needed to promote the electrons involved [Lee 2005, 83; Choudhury 2014, 65]. The absorbed monochromatic radiation has a frequency corresponding to the energy gap between the two quantised energy levels as previously expressed equation (5.3). Nevertheless, Bohr-Einstein frequency condition is a necessary but not sufficient condition for a transition to occur. In fact, the absorption (and emission) mechanism occurs in accordance with certain *selection rules*. Selection rules indicate which quantum numbers and how much magnitude change in a given spectroscopic transition. The transition is denominated *allowed* if it is favoured by a selection rule and *forbidden* if it does not follow a selection rule. Nevertheless, most selection rules are formulated assuming that real systems are ideal. For this reason, some forbidden transitions may actually occur [Ball 2001, 91].

In the absorption of light by polyatomic molecules, the total energy of a molecule is given by the Born-Oppenheimer approximation:

$$E = E_{electronic} + E_{vibrational} + E_{rotational} \quad (5.4)$$

Moreover, the energies required for exciting the different energy levels are so that:

$$E_{electronic} >> E_{vibrational} >> E_{rotational}$$

Electronic energy is then related with the transitions of an atom from the ground state energy level to an excited state energy level of the molecule due to absorption of a photon of suitable frequency. Vibrational energy concerns the motion of nuclei of molecules and rotational energy is associated with the rotation of the molecule around an axis perpendicular to the internuclear axis. All these motions are quantised and independent between them [Tkachenko 2006, 7; Gupta 2015, 313; Kakkar 2015, 305].

To each electronic state a series of vibrational energy levels are associated and to each vibrational energy level, a number of rotational energy levels are associated (***Figure 5.6***) [Ball 2012, 488; Gupta 2015, 321].

The rotational spectrum of a molecule is observed in the far-IR and microwaves regions of the electromagnetic spectrum. The vibrational one is observed in the IR region. Finally, the electronic spectrum of a molecule is observed in the UV-Vis region, since considerably higher energies are involved [Tkachenko 2006, 7].

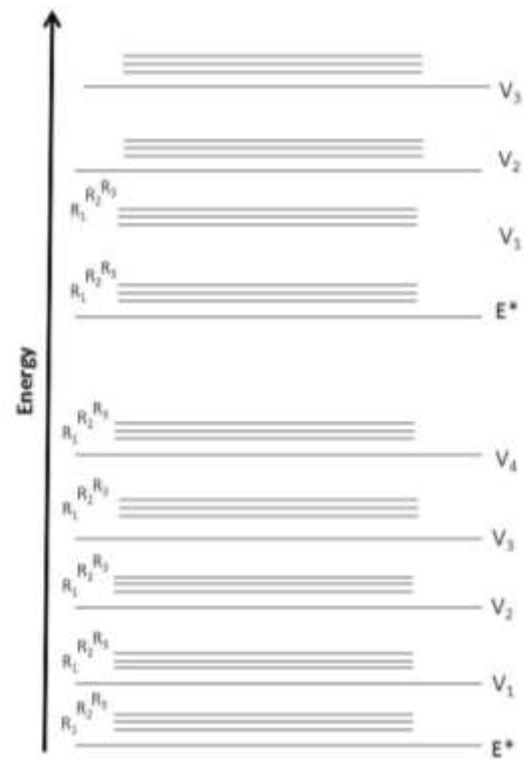


Figure 5.6. Molecular energy diagram (E*– excited electronic states; V– vibrational states; R– rotational states).

In this chapter, particular focus will be given to the electronic transitions since they are in the basis of pigment identification with FORS methodology in the UV-Vis. The electronic transitions are also among the causes of colour as it will be discussed in in ***section 5.3*** [Nassau 1997, 126].

Absorption of light by a semi-transparent or diluted solution or gas is governed by the Lambert-Beer law in the UV-Vis and IR-regions:

$$A=\varepsilon \cdot c \cdot d \tag{5.5}$$

A stands for absorbance [log (I_0/I)] (I_0 is the intensity of the monochromatic incident light that interacts with the sample and I, the intensity of light emerging from the sample after absorption); ε is the absorption coefficient, characteristic of the substance and dependent of the wavelength. c is the concentration of light-absorbing substance. d is the path length of the light through the sample [Perkampus 1992, 3 ; Robinson 1996, 27].

Between absorbance and transmittance (T) there is the following relationship:

$$A= \log (I_0/I) = \log (1/T) \tag{5.6}$$

Light transmission is calculated by ratio between the intensity of radiation that goes through and emerges from a sample (I) and the intensity of the incident radiation that travels through the material (I_0) [Perkampus 1992, 3; Vieil 2012, 239].

b) Reflection and Refraction

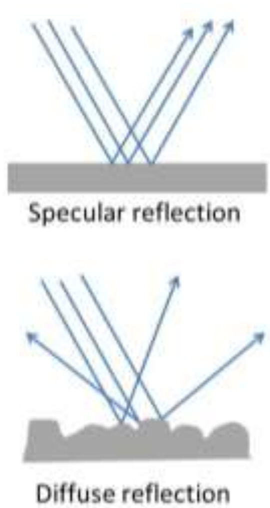


Figure 5.7. Specular and diffuse reflection (According to Crowell 1999, 15).

Reflections of light beam can contain both specular and diffuse components. These phenomena depend on factors such as: material of the surface, wavelength of the incoming ray and ray's angle of incidence of the ray. The roughness of the surface relative to light wavelength determines the shape of the reflected radiation pattern. When the surface is smooth it acts like a mirror [Mac Adam 2013, 43; Kavehrad *et al.* 2016, 34]. This means that practically all reflected light travels back in definited directions, in the same angle as it came in, in respect to the normal. This mirror like reflection at a specific angle is known as specular reflection [Crowell 1999, 15; Fincham and Freeman 2013, 12]. A rough surface relative to the wavelength of the incident light reflects it in several directions and there is no radiation pattern [Kavehrad *et al.* 2016, 34]. This reflection is called diffuse (***Figure 5.7***) [Nassau 1997, 10; Fincham and Freeman 2013, 12].

Note that reflectance spectroscopy deals with spectral composition of the radiation specular or diffusely reflected by the surface of an object [Bacci 2000, 326]. In diffuse reflectance spectroscopy, the depth of penetration of radiation depends of several factors, such as: materials chemical composition, sample density, refractive index, particle size and morphology [Derrick *et al.* 1999, 65; Bacci *et al.* 2009b, 198]. In UV region the depth of penetration can be of a few microns while in the NIR region it can easily reach one hundred microns [Bacci *et al.* 2009b, 198].

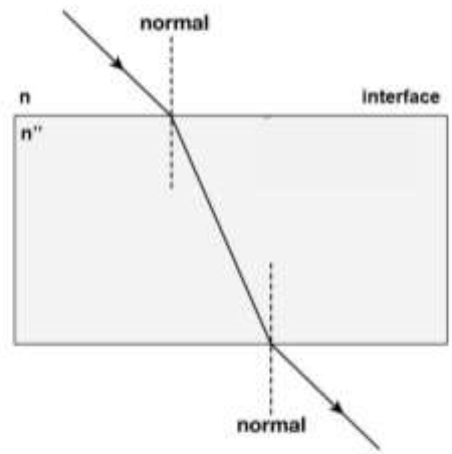


Figure 5.8. Refraction of light at the interface between two media of different refractive indices, with n''> n.

Imagining the situation when light is incident obliquely to the surface between two different media its direction can change when passing from a medium to another (***Figure 5.8***). It is said to be refracted [Fincham and Freeman 2013, 17]. In other words, refraction is the bending of a radiation wave when it enters into a medium where its velocity is different.

Refractive index (n) is given by the ratio between the velocity of light in vacuum (c) and the velocity in the new medium (5.7). Note that the refractive index of a medium varies with the wavelength of light [Choudhury 2014, 62].

$$\frac{c}{v} = n \tag{5.7}$$

Snell's law gives a relationship between the angles of incidence (ϕ) and refraction (ϕ'') and the indices of refraction of the two media (5.8). The total reflection occurs when ϕ is a critical value and $\phi''=90º$.

$$n \cdot \sin\phi = n'' \cdot \sin\phi'' \tag{5.8}$$

Specular reflectance (R) from a smooth surface at normal incidence to the surface or on leaving the material is, by its turn, given by Fresnel's formula (5.9):

$$R = \frac{(n'' - n)^2}{(n'' + n)^2} \tag{5.9}$$

n is the refractive index of the initial medium (usually air) and n'' is the refractive index of the new medium [Choudhury 2014, 63].

5.2.2 The Kubelka-Munk theory

The Lambert-Beer law, previously presented, regards transmission and not to reflectance, where radiation can be also scattered. This law assumes samples in which the light intensity is not lost by scattering and reflection processes. Nevertheless, in the case of samples which scatter strongly or are opaque to light (but does not absorb it), the incident light is reflected diffusely [Perkampus 1992, 95]. In this situation, the reflecting power is also a function of the absorbing power of the substance. This fact is evident in the colour observed by the substance. The eye perceives not the colour that is absorbed but the one that is reflected [Perkampus 1992, 95].

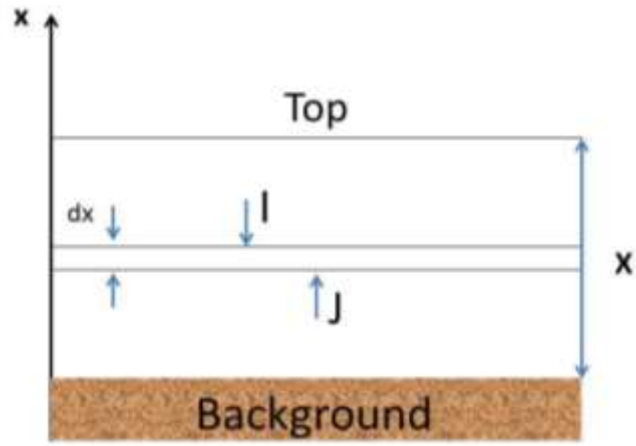


Figure 5.9. KM theory: the incident and scattered fluxes are approximated by two opposite fluxes perpendicular to the surface of the infinitely thick sample layer.

Diffuse reflection is a very complex phenomenon, but Kubelka-Munk (KM) theory (1931) provides some approximations[293]. In the KM theory it is assumed that the incident and scattered light fluxes are approximated by two fluxes **I** and **J**. Both are perpendicular to the surface of the powdered sample, but in opposite directions (***Figure 5.9***). I represents the flux of monochromatic diffuse illumination and J the flux of diffusely scattered light [Weckhuysen *et al.* 2000, 224]. The mathematical treatment results in equation (5.10). $F(R_\infty)$ is the KM function and is used in reflectance spectroscopy. It assumes diffuse reflecting power of an homogeneous material with infinite thickness[294] (R_∞), the characteristic absorption coefficient (K) and scattering coefficient (S) of sample under research [Kubelka and Munk 1931; Perkampus 1992, 95; Bacci 2000, 326; Weckhuysen *et al*. 2000, 224; Kubik 2007, 204]:

$$F(R_\infty) = \frac{(1 - R_\infty)^2}{2R_\infty} = \frac{K}{S} \tag{5.10}$$

The relationship between R_∞ and the ratio K/S is represented in ***Figure 5.10***. The scattering coefficient was introduced into the theoretical description of diffuse reflection as a semi-empirical parameter taking into account internal scattering processes. The scattering coefficient is dominated by particle size and refractive index of the sample. This coefficient varies slowly with wavelength and does not

[293] Kubelka and Munk 1931 and Kubelka 1948 and 1954.
[294] In other words, "infinitely thick" means that none of the incident radiation on the samples penetrates to the bottom of the sample holder [Mirabella 1998, 192].

depend on the absorption coefficient. Nevertheless, it changes significantly with packing density [Kubik 2007, 204].

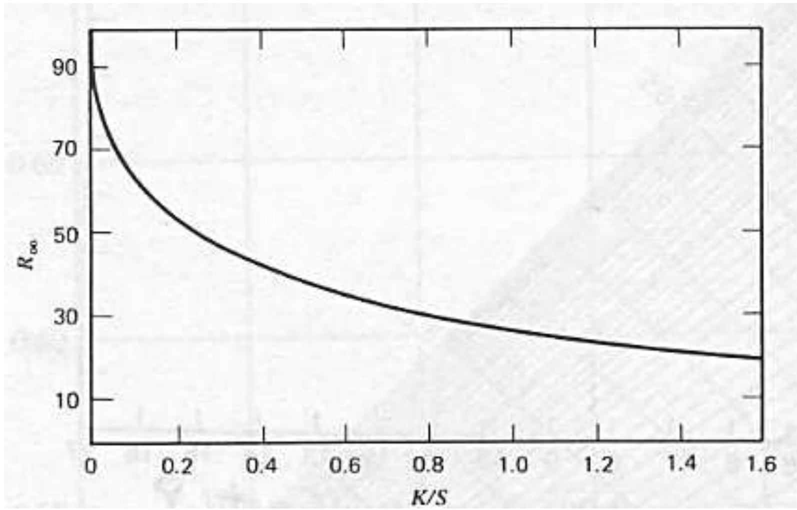


Figure 5.10. Theoretical plot representing the relationship between R_∞ and K/S [Mitton 1973].

Experimentally, R_∞ is measured as the ratio between the intensity of light reflected from the sample (R_{sample}) and the intensity of light reflected from and ideal white reference standard ($R_{standard}$). A relative value R_∞ is obtained according to the relation 5.11:

$$R_\infty = \frac{R_{sample}}{R_{standard}} \tag{5.11}$$

Note that if the absolute reflecting power of a standard ($R_{standard}$) is equal to 1 (or 100%), the reflecting power of the sample in analysis would be the same as R_∞. However, currently, there is no known white standard material which shows this feature in the spectral range UV-Vis-NIR [Perkampus 1992, 96].

It is worth also to refer that a reflectance spectrum can also be converted in apparent absorbance (A') spectrum according to the following relation (5.12), by analogy with transmission measurements [log (1/T)] (6):

$$A' = \log(1/R) \tag{5.12}$$

Both equations (5.10 and 5.12) try to represent the relationship between the spectral intensity and the sample concentration in a linear way.

5.3 Electronic Spectroscopy

As previously mentioned, UV-Vis-NIR spectroscopy involves specially the study of electronic transitions that may occur between different electronic levels and observed in UV-Vis range [Bacci 2000, 324]. The several possible mechanisms of electronic transition will be now discussed.

5.3.1 Transition between delocalised molecular orbitals

The transitions between delocalised molecular orbitals regard organic compounds and usually occur in the Vis or very near UV range [Bacci 2000, 324]. The absorption of these radiations is a result of the excitation of bonding electrons to an antibonding orbital, according to molecular orbital theory [Yadav 2013, 9]. As consequence there is a relation between the wavelengths absorption peaks and the type of bonds in the species under analysis. The electrons that participate in the absorption are related with orbitals σ, π and n [Skoog *et al.* 1998, 330]. The electrons responsible for single bonds are σ electrons. π electrons are responsible for double bounds. Finally, n electrons are nonbonding electrons present in molecules containing atoms like nitrogen or oxygen [Rao 1975, 14].

Figure 5.11 shows how energy varies according to different types of molecular orbitals. Nonbonding electrons are bound less strongly than the bounding electrons. Thus, they require smaller absorption radiation to excite electrons to higher energy levels. Among the bounding electrons, σ electrons are more strongly bound than π electrons. In the antibonding levels, σ^* energy level is higher than π^* level [Rao 1975, 14].

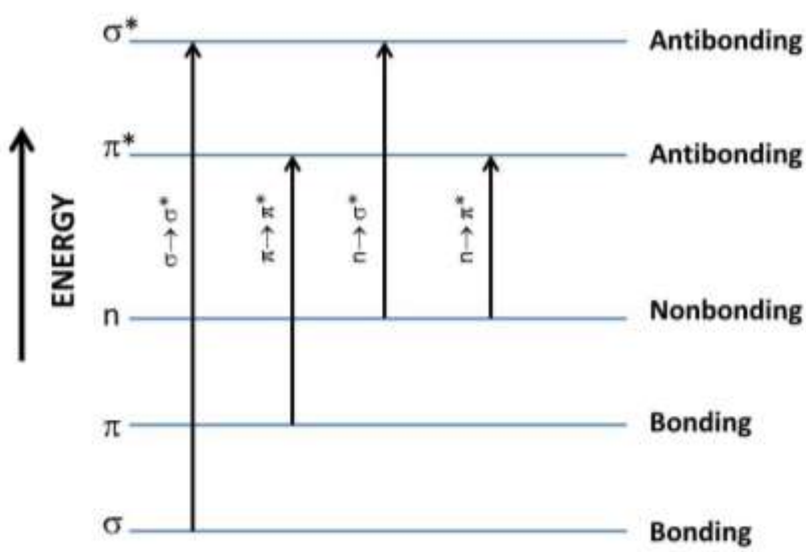
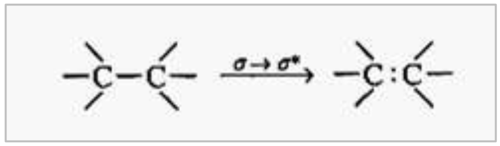
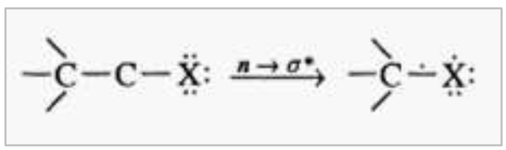


Figure 5.11. Electronic transitions in organic compounds (According to Skoog *et al.* 1998, 331).

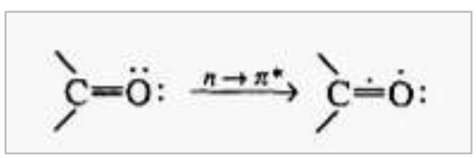
• *σ→σ* transitions* occur in saturated hydrocarbon molecules. In this case, a bonding σ orbital of a molecule is excited by the absorption of radiation to an antibonding orbital σ*. As seen in ***Figure 5.11***, σ bonds are very strong and require high energy to promote this transition, which corresponds to vacuum ultraviolet frequencies [Rao 1975, 14; Kalsi 2007, 11; Yadav 2013, 10].



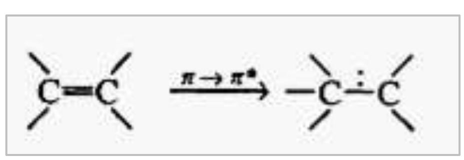
• *n→σ* transitions* are observed in saturated compounds containing atoms with nonbonding electrons (unshared electron pairs) as auxochromes[295] like C–OH, C–NH_2, C–halogen etc. These transitions usually require less energy than the former case, corresponding to the far or sometimes near ultraviolet region [Rao 1975, 15; Yadav 2013, 11].



• *n→π* transitions* occur near ultra-violet or visible region when a hetero atom with unshared electrons pair is multiply bounded to another atom. These transitions concern the promotion of an electron from a nonbonding orbital n to an antibonding orbital π*. Example of this are chromophores like C=O, C=S, –N=N– etc. These compounds also observe *n→σ** and *π→π** transitions at lower wavelengths [Rao 1975, 15]. *n→π** involves least amount of energy than other transitions [Kalsi 2007, 13; Yadav 2013, 11].



• *π→π* transitions* are found in the ultraviolet region and occur from a π bonding orbital to a π antibonding orbital. These transitions are observed in compounds containing one or more covalent unsaturated groups like alkenes, aromatics, carbonyl compounds. This transition requires less energy than *n→σ** transitions [Kalsi 2007, 13; Yadav 2013, 11].



[295]An *auxochrome* is a group in a molecule that does not confer colour on a substance whereas a *chromophore* is a group that promotes colour on a substance [Rao 1975, 13].

Indigo, alizarin and curcumin are examples of organic pigments and dyes that show a very intense colour [Bacci 2000, 324; Choudhury 2014, 84]. Their absorbance bands are observable in the Vis or very near UV. In fact, it is necessary for an organic molecule to absorb visible radiation to have an electronic structure that allows the electron delocalization over a wide space interval [Bacci 2000, 324]. This is possible when there is a "conjugated" organic compound of long chain presenting alternate single and double bounds. As consequence of such arrangement, there are *π-bonding* electrons related with the second bond of the double bond which are no longer localised but can be considered belonging to the whole conjugated chain. In this situation, the excited states of such electrons occur at much lower energies in comparison with the usual paired electrons. For example, the absorption bands of conjugated cyclic benzene C_6H_6 or the linear 2,4 hexadiene $CH_3–CH=CH–CH=CH–CH_3$ occur in UV while the conjugated linear ten-carbon chain 2,4,6,8 decatetraene $C_{10}H_{14}$ with higher molecular weight show a absorption band in the blue range of the visible spectrum, presenting a pale-yellow colour [Nassau 1987].

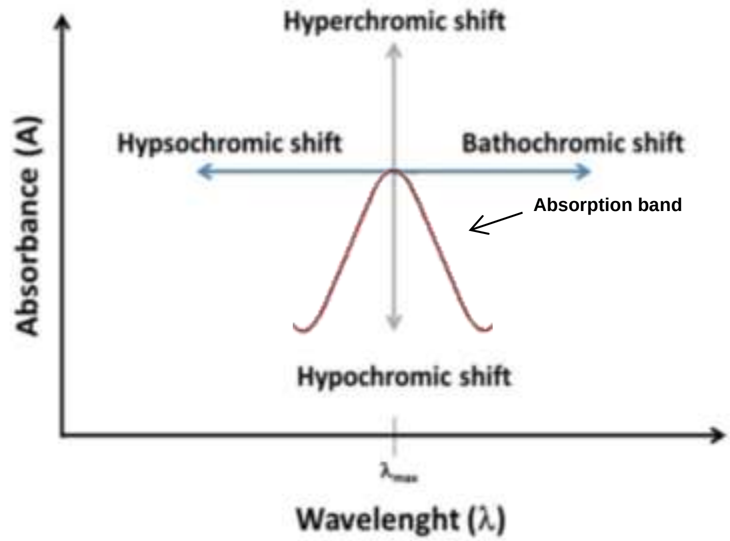


Figure 5.12. Bathochromic, Hypsochromic, Hyperchromic, Hypochromic shifts summarized (According to Yadav 2015, 16).

The absorption of visible radiation may occur easier when in conjugated chains observe substitution or structural changes, which promote alterations in wavelength and in intensity of absorption bands.

When a wavelength changes to a longer wavelength, the phenomenon is called *bathochromic* shift (*red shift*) and if changes to shorter wavelength is called *hypsochromic* shifts (*blue shift*). An increase in the absorbance intensity inside a band is called a *hyperchromic* effect, while a decrease is called *hypochromic* effect (***Figure 5.12***) [Rao 1975, 16; Yadav 2013, 16].

Bathochromic shift may be observed when there is presence of both electron-donor and electron-acceptor groups[296] far from each other. Hypsochromic shift may be observed especially if electron acceptors are involved [Herbst and Huger 2006].

[296] Acceptor groups: NO_2, NO, CN. COOH, COO^-, $CONH_2$, CNHR, $CONR_2$, CHO, SSI, SO_2R, $SO_2C_3F_7$, SO_2CH_3, COR, $COCF_3$, CF_3, $COCH_3$, $CH=C(CN)_2$, $C_2(CN)_3$, SO_2NH_2, N_2^+, NH_3^+, $N(CH3)_3^+$ and aromatic (R is an alkyl group)
Donor groups: NH_2, $NHCH_3$, $N(CH_3)_2$, NHR, N_2H_3, F, Cl, Br, I, SH, SR, OR, CH_3. OH, $NHCOCH_3$, OCH_3, SCH_3, OC_6H_5, $C(CH_3)_3$, $COOCH_3$, O^-, S^- and aromatic (R is an alkyl group). Aromatic group is capable of both kinds of effects [Nalwa *et al.* 1996, 96]

5.3.2 Charge-transfer transitions

The charge-transfer transitions occur between molecular orbitals, located in different sites of a molecule or crystal [Bacci 2000, 325]. The process occurring is called *intervalence charge transfer* and concerns to electron movement from one transition-metal ion to another by means of absorption of light energy. This results in a temporary change in the valence state of both ions [Nassau 1987]. Examples of these mechanisms are:

• *Heteronuclear intervalence charge transfer* which occurs between two different metals [Nassau 1987]. For example, in corundum crystals in sapphire, Al_2O_3, Al^{3+} ions are substituted by Fe^{2+} and Ti^{4+} ions from impurities. The electron transfer from Fe to Ti process is presented as:

$$Fe^{2+} + Ti^{4+} + h\cdot\nu \rightarrow Fe^{3+} + Ti^{3+}$$

These electronic transitions promote a temporary change in the valence state of ions. The energy necessary to excite electrons corresponds to the yellow range of visible spectrum (***Figure 5.13***). Thus, these transitions are responsible for deep-blue colour of sapphire [Nassau 1987].

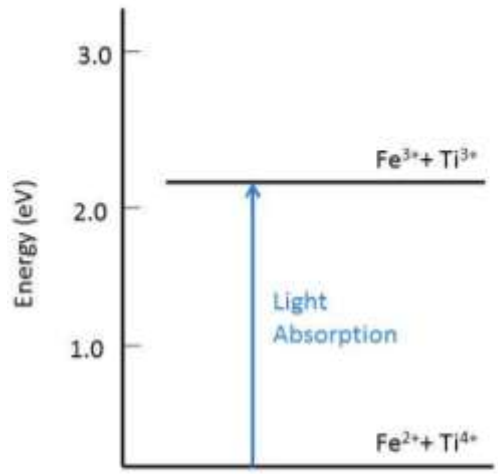


Figure 5.13. Transition from the ground state to the excited state in blue sapphire (According to Nassau 1987).

• *Homonuclear intervalence charge transfer* happens between two different valence states of the same metal and also in two different sites A and B [Nassau 1997b]. This mechanism occurs for example in Prussian blue, $Fe_4\,[Fe(CN)_6]_3\cdot 14H_2O$ or $KFe[Fe(CN)_6]\cdot H_2O$ [Nassau 1987; Bacci 2000, 325]:

$$Fe_A^{2+} + Fe_B^{3+} + h\cdot\nu \rightarrow Fe_A^{3+} + Fe_B^{2+}$$

• *Metal-ligand charge transfer* are observed in some inorganic pigments as chrome yellow, $PbCrO_4$, where the absorbed radiation causes the electron transfer from O^{2-} to Cr^{6+} forming the chromate ion $[CrO_4]^{-2}$ [Nassau 1987; Bacci 2000, 325].

• *Anion-anion charge transfer* are found, for example, in ultramarine blue, $Na_{8-10}[Al_6Si_6O_{24}]S_{2-4}$ where charge transfer happens between S_2^- and S_3^- in the lattice of the complex aluminosilicate [Nassau 1987; Bacci *et al.* 2009; Aceto *et al.* 2013].

5.3.3 Ligand field transitions (*d-d*)

Ligand field theory applies the molecular orbital theory to transition metal complexes. In most inorganic substances, it is required extremely high energy to excite paired electrons resulting in electronic absorptions. Nevertheless, when a transition-metal compound is present, their unpaired electrons in *d* orbitals promote absorptions that can occur at lower energies [Nassau 1987]. These orbitals own appropriate energy to form bonding interaction with ligands. A ligand is an ion or molecule that binds to a central atom to form a coordination complex [Choudhury 2014, 81]. The metal ion is surrounded by ligand ions or molecules that promote field acting upon the central ion orbitals. This resolves the degeneracy of the 5 *d* orbitals of transition metal ions. Note that the energy of different *d* orbitals depends of the ligand type, number and geometry of the complex [Bacci 2000, 325]. Another example occurs with the Co^{2+} ion, which is coordinated to 4 oxygen atoms in a near tetrahedral geometry in smalt and to 6 oxygen atoms in a near octahedral geometry in cobalt violet (***Figure 5.14***). In the former case, only one transition is observed in the Vis range. In the latter case, two transitions, also with a different line shape, occur in the same interval with a resulting colour shift from blue to violet [Bacci 2000, 325].

The ligand field transitions are characteristic of many inorganic pigments such as azurite, malachite, smalt, cobalt blue or cobalt violet [Bacci 2000, 325].

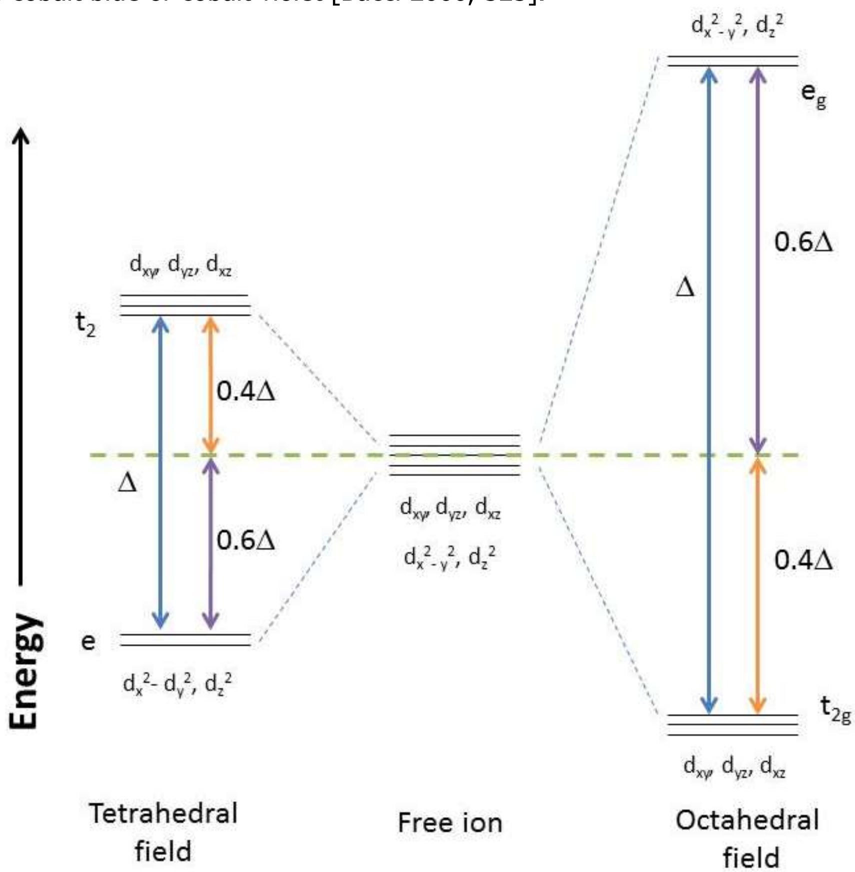


Figure 5.14. The "splitting" of five 3*d* orbitals in a tetrahedral and an octahedral ligand-field (According to Nassau 1987).

5.3.4 Band-to-band transitions

The band-to-band transitions are found, for example, in pigments constituted by semiconductors (e.g. vermilion, cadmium yellow, litharge, minium, and orpiment) [Bacci 2000, 325]. In these materials, orbitals on adjacent atoms overlap to form the so-called *valence band* that contains the valence electrons of all atoms. Empty outer orbitals overlap to form the *conduction band*, which lies at a slightly higher energy respect to the valence band. Both bands are separated by an energy gap, E_g (***Figure 5.15***) [Nassau 1997; Skoog *et al.* 1998, 152]. These materials present an absorption band characterised by a sigmoid shape [Bacci 2000, 325]. For example, cadmium yellow's energy gap is around 2.6 eV and vermilion's around 2.0 eV [Nassau 1997].

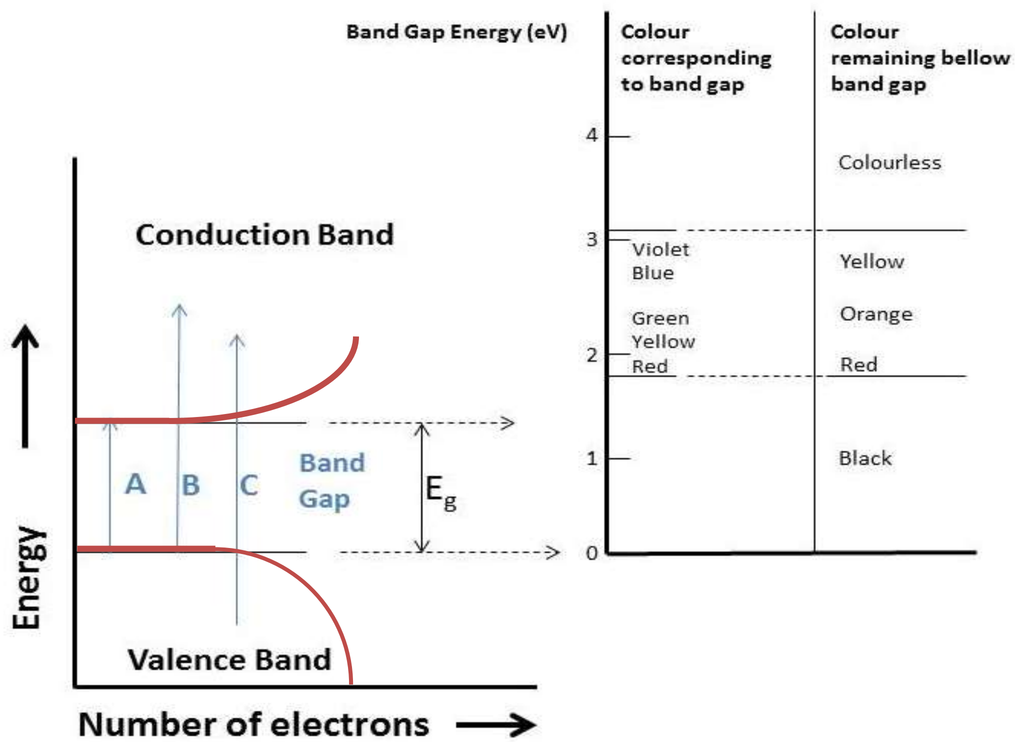


Figure 5.15. *On the left:* The absorption of light in a band-gap material.
On the right: The variation of colour with the size of the band gap (According to Nassau 1987).

5.4 UV-Vis-NIR Diffuse Reflectance Spectrophotometers (DRS)

5.4.1 Instruments

A spectrophotometer is an instrument that collects information (spectrum) concerning the intensity of the quantity of reflected, absorbed or transmitted radiation by a surface/sample (solid, liquid or gas) *versus* a parameter, such as wavelength or frequency.

In the case of reflectance spectrophotometers, these devices measure the diffuse radiation factor by the surface in the UV-Vis-NIR range, by comparison with a high reflecting reference standard as such as 99% *Spectralon*® or barium sulphate ($BaSO_4$) plates. A reflectance spectrum usually reports the percentage of reflected radiation *versus* the wavelength [Bacci *et al.* 2009b, 197].

The configuration of a spectrophotometer presents (1) light source, (2) split up (dispersion element that decomposes the light into its wavelengths by a prism or grating monochromator) located before or after the (3) sample compartment and (4) detector/readout system. These devices are also called dispersive spectrophotometers and allow the continuous variation of wavelength over the whole spectral range under analysis [Perkampus 1992, 12].

As other spectrophotometers, there are two categories of UV-Vis-NIR reflectance spectrophotometers: single beam and double beam instruments.

In single-beam spectrophotometers (***Figure 5.16***), light travels in a unique beam and interacts with the sample. In this case, in order to calculate the percentage of diffuse reflectance radiation, a first measurement is carried out on the reference standard and recorded by the device. Afterwards, measurements on the sample are performed. The radiation is subsequently decomposed by the dispersion element. Through adequate slits, each wavelength is selected and hits the sample. Radiation is then revealed by a suitable detector. Note that the dispersion element can be located before the sample (conventional spectrophotometer) or between the sample and the detector. When this situation occurs, spectrometers are usually called spectroanalysers.

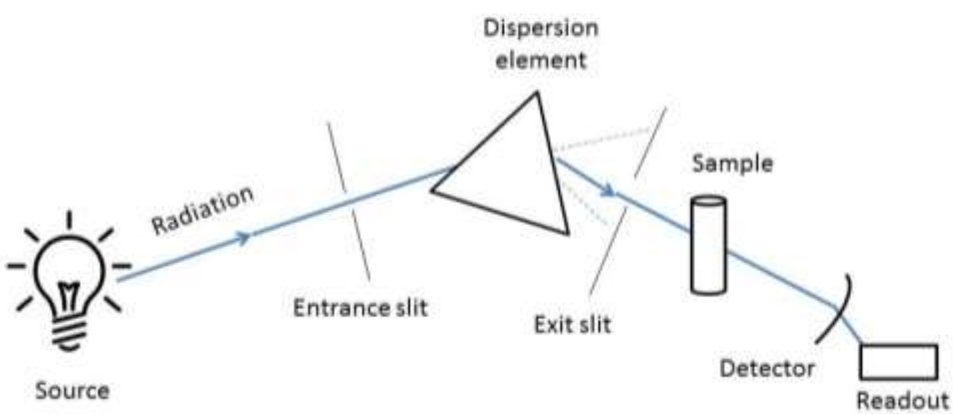


Figure 5.16. Example of Single-beam instrument (According to Robinson 1996, 31).

In a double-beam spectrophotometer (***Figure 5.17***), two beams of light are obtained through a beam splitter or chopper. As the previous case, it can be located before the sample or between the sample and the detector. One of the beams interacts with a reference sample and the other with the sample in analysis. Both beams have equivalent energy and optical paths. After both beams have been refocused, light of varying intensity arrives onto the detector and generates an alternating-voltage signal. These devices can also be equipped with double monochromator. They provide more stable and efficient measurements than the single beam devices. However, single-beam spectrophotometers are optically simpler and more compact.

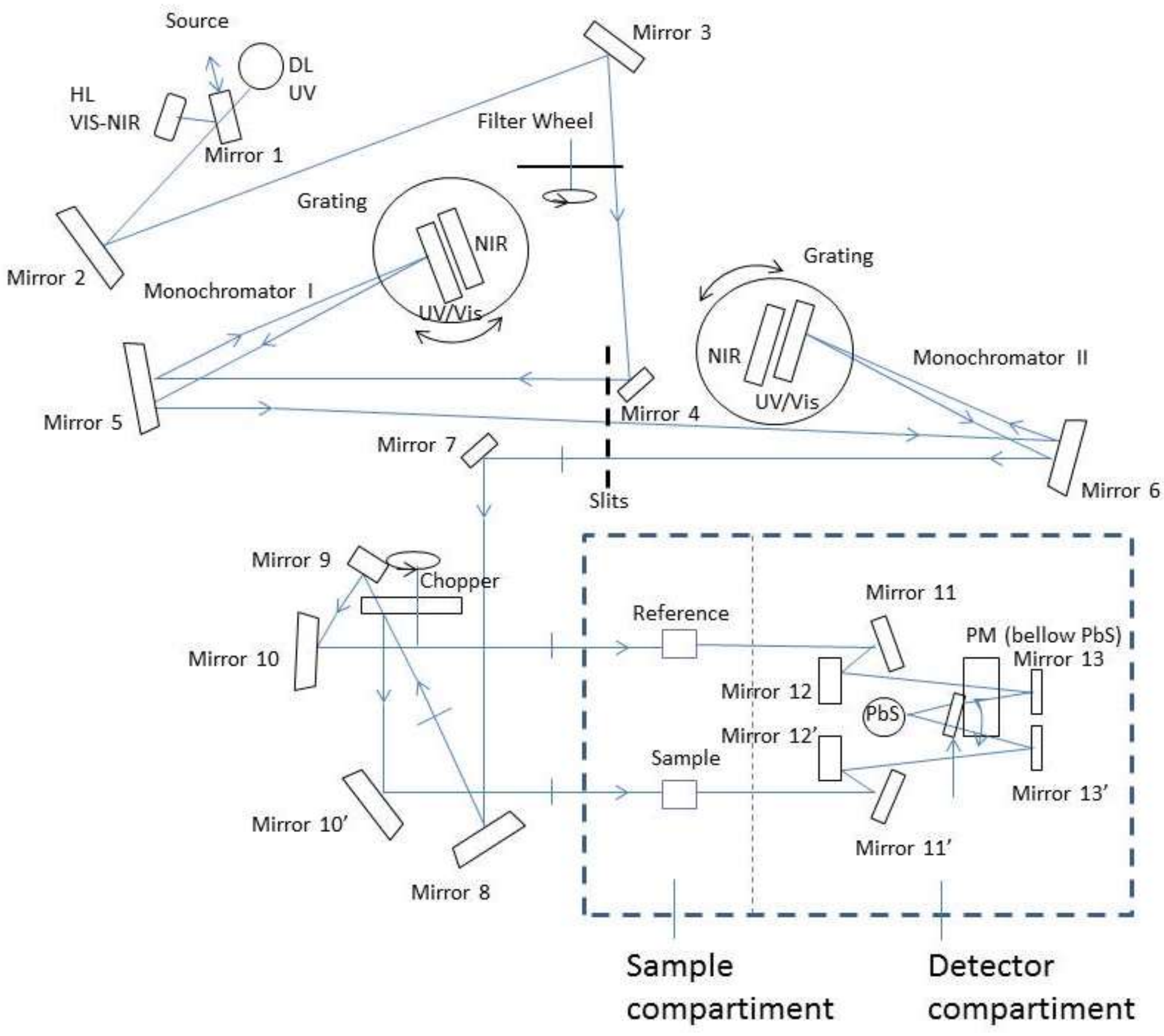


Figure 5.17. Example of Double-beam and double monochromator UV-Vis-NIR instrument (According to Perkampus 1992, 13).

The double-beam UV-Vis-NIR spectrophotometers own an integrating sphere for diffuse reflectance (***Figure 5.18***). An integrating sphere is a hollow spherical cavity. Its inner surface is coated with a highly reflective material (e.g. 99% *Spectralon*® or $BaSO_4$) and small ports for in and out of radiation. Light enters in the sphere at different angles and is "homogenised" by multiple reflections. The entering ray strikes any point of the interior surface from any angle and illuminates the entire surface of the sphere at constant irradiance [Stewart 1996, 99; Mac Adam 2013, 43]. The integrating sphere makes possible the analysis of reflectance spectra from opaque materials and is especially useful for measurements in thin layers such as paper and highly opaque materials [Mac Adam 2013, 44]. This accessory also provides the measurement with geometry configurations 0º/d and 8º/d for specular reflectance exclusion [Workman Jr. and Springsteen 1998, 209].

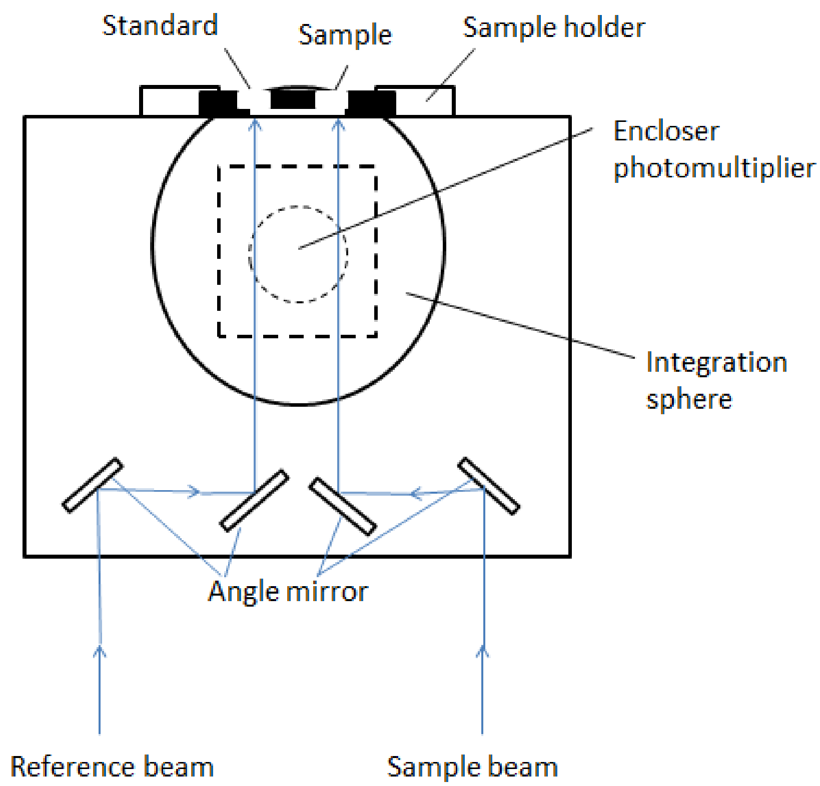


Figure 5.18. Integrating sphere accessory (According to Perkampus 1992, 98).

Colours on the painter's palette evoke a double effect:
a purely physical effect on the eye which is charmed by the beauty of colours,
similar to the joyful impression when we eat a delicacy.

Wassily Kandinsky from *Concerning the spiritual in art* (1911)

CHAPTER 6: Modern Watercolours Reflectance Spectra Database

6.1. Preamble

Analysis with FORS methodology always requires the creation of a suitable spectra database of artist's materials. The spectral comparison between those spectra and the unknown data allows the identification of the materials present in the sample or surface in study. As referred by Bacci *et al.*(2009) these reference spectra must be acquired from mock-ups prepared by following the techniques and pictorial materials used by artists as closely as possible [Bacci *et al.* 2009, 199].

Figure 6.1. FORS analysis on *La Légende de Saint Julien l'Hospitalier*.

Only a handful of studies regard the creation of reflectance spectral libraries on artist's materials [Moneta 2005; Boselli 2010; Montagner *et al.* 2011; Aceto *et al.* 2014]. Since 1983, within the analysis at the Brancacci Chapel in Florence, IFAC-CNR is carrying out an accurate database for FORS analysis. Currently, this institution makes available the access to two databases of pictorial materials: (1) FORS database in the range 270-1700 nm[297]: http://fors.ifac.cnr.it/, which include the pigments and dyes most used by artists in the past and ground in egg tempera and oil painting and (2) UV-Vis-NIR modern pigments spectral database in the range 200-2500 nm obtained from a double-beam double-monochromator laboratory spectrophotometer of diffuse reflectance (DRS): http://drs.ifac.cnr.it.

In this chapter, the results obtained from a modern watercolour reflectance spectra database created and used for the characterisation of the pictorial materials used by Amadeo de Souza--Cardoso in *La Légende de Saint Julien l'Hospitalier* in ***Chapter 4*** are presented and discussed. The database includes spectra from the UV-Vis-NIR range (350-2500 nm) analysed by FORS and also by a laboratory diffuse reflectance spectrophotometer (DRS). This database is available to conservation scientists and researchers through the IFAC-CNR website: http://mowcres.ifac.cnr.it.

[297]It was built in collaboration with the *Opificio delle Pietre Dure* (Florence, Italy).

6.2. Experimental

6.2.1. Watercolour mock-ups preparation

Since the 18th century, Chemistry developments led to the production of panoply of new pigments. In this study, thirty pigments (***Table 6.1****)* were selected for the creation of the modern watercolour reflectance spectra database. The choice was based on pigments produced in the early 20th century and, in particular, regards the colour preferences of Amadeo de Souza-Cardoso [*see* ***Chapter 4, section 4.5*** and ***Appendix A6.1***]. The commercial pigments used for the watercolours mock-ups preparation were purchased from *Winsor & Newton* (London, England), *Zecchi* (Florence, Italy), *Di Volo* (Siena, Italy), *Aldrich* (Saint Louis, USA) and *Carlo Erba* (Milan, Italy). They were previously characterised by means of μ-Energy-Dispersive X-Ray Fluorescence Spectroscopy (μ-EDXRF), Fourier transform infrared spectroscopy (FTIR) (when necessary, Raman microscopy (μ-Raman)) for pigment's confirmation [*see* ***Appendix A6.2***].

Aiming studying the influence of paint dilution in the obtained reflectance spectra, the mock--ups were prepared grinding each pigment in a solution of 10% of Arabic gum in water (w/v). Five different dilutions were obtained: 5%, 10%, 20%, 30% and 40%. The paints of each dilution were spread with brush on laboratory *Whatman* paper [*see* ***Appendix A6.3***].

Table 6.1. Pigments selected for IFAC-CNR modern watercolours database.

Amadeo's colours selected					
Cobalt violet arsenate (W&N)	Prussian blue (Zecchi)	Viridian (Zecchi)	Cadmium orange deep*	Yellow ochre (Zecchi)	Barium sulphate (Carlo Erba)
Cobalt violet phosphate (Di Volo)	Ultramarine blue, synthetic (Zecchi)	Carmine (Zecchi)	Cadmium orange light*	Raw Siena (Zecchi)	Lithopone (Zecchi)
Cerulean blue (Zecchi)	Chrome oxide green (Zecchi)	Rose Madder (Zecchi)	Cadmium yellow (Zecchi)	Burnt Siena (Zecchi)	Graphite (Zecchi)
Cobalt blue (W&N)	Cobalt green (Zecchi)	Vermilion (Zecchi)	Chrome yellow (Aldrich)	Lead white (Zecchi)	Ivory black (Zecchi)
Indigo (Zecchi)	Schweinfurt green (Zecchi)	Cadmium red (Zecchi)	Naples yellow (Zecchi)	Zinc white (Zecchi)	Vine black (Zecchi)

*Cadmium orange deep: solide mixture 80% Cadmium yellow + 20%Cadmium red (Zecchi);
Cadmium orange light: solide mixture 50% Cadmium yellow + 50% Cadmium red (Zecchi).

6.2.2. Instrumental set-up

- **UV-VIS-NIR FORS**

FORS measurements in the 350-2200 nm range were performed by using a portable device constituted by two Zeiss spectroanalysers equipped with optical fibre bundles (***Figure 6.2***): the models MCS601 and the MCS611 NIR 2.2 WR operating in the 200-1000 nm and 900-2200 nm ranges, respectively. It makes possible to obtain reflectance spectra from UV to NIR in just a single measurement with an acquisition step of approximately 0.8 nm/pixel for the model MCS 601 UV-Vis (1024 silicon photodiode array detector) and 6 nm/pixel for the model MCS 611 NIR 2.2 WR (256 InGaAs photodiode array detector). The spectroanalysers are mounted on a single chassis together with the light source, a 20W halogen tungsten lamp with colour temperature of about 3000 K and emission range from 320 to 2500 nm (model CLH600). Calibration of the spectroanalysers was performed by means of a white diffuse reflectance standard 99% *Spectralon*®.

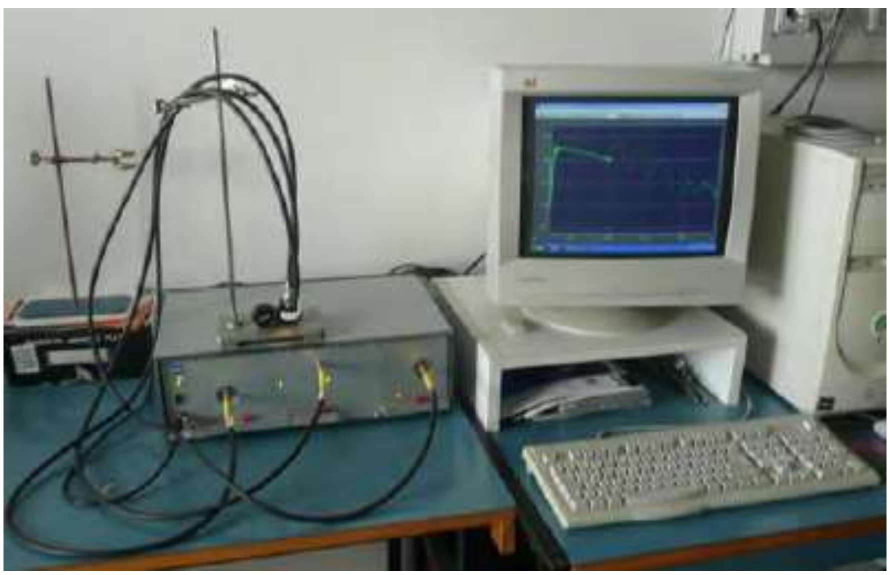


Figure 6.2. IFAC-CNR FORS instrument.

As described by Bacci *et al.* (2009), the fibre optic system sends the emitted radiation by the light source to the sample and collects the backscattered radiation directly to the dispersive element (grating) and subsequently to a suitable detector. Fibre optic bundles are composed by two extended coaxial cylinders: (1) the inner one is called *core* and has high reflective index and (2) the exterior one is called *cladding* and has lower reflective index. The optical fibres are protected by a coat made by a non-optical material like metal or plastic [Bacci *et al.* 2009, 197]. The set of fibres is made in silica and it transmits radiation from the entire range UV-Vis-NIR [Bacci *et al.* 2009, 198].

The design of the probe-head determines the geometry for illumination. In this study, two geometries were used with FORS methodology. The first probe-head has 0º/2x45º geometry (***Figure 6.3***). This means that light interact with the sample from the aperture located on the dome of the semi-sphere at 0º. The back-scattered radiation is received by the other two apertures at 45º. With this probe geometry, an approximately 2 mm diameter area can be investigated.

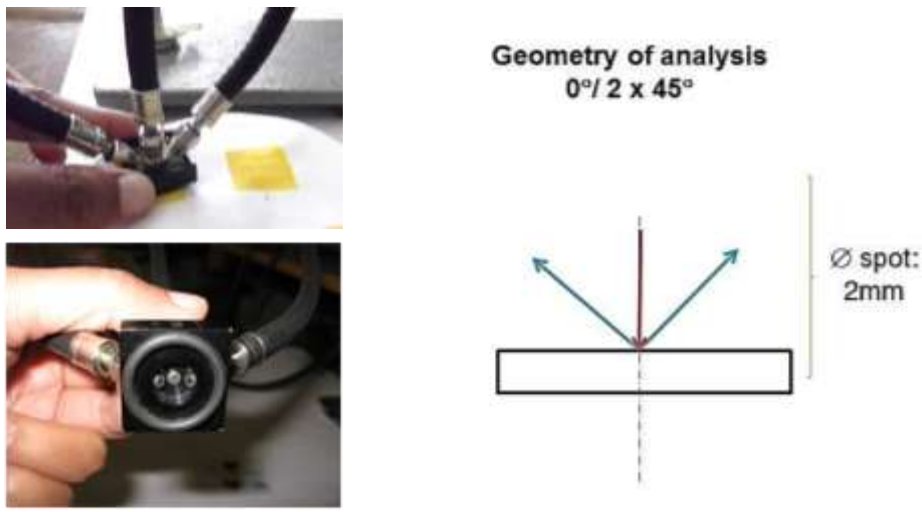


Figure 6.3. Geometry of analysis 0º/2x45º (red line: illumination; blue line: back-scattered radiation).

Analyses were also carried out with 8°/8° geometry of measurement (***Figure 6.4***). With this geometry the illumination was sent almost perpendicularly to the surface (8°) and the back scattered radiation was collected at the same direction of the illumination (back-scattered radiation), so as to reduce the area effectively measured on the surface to a very small spot of about 1 mm diameter.

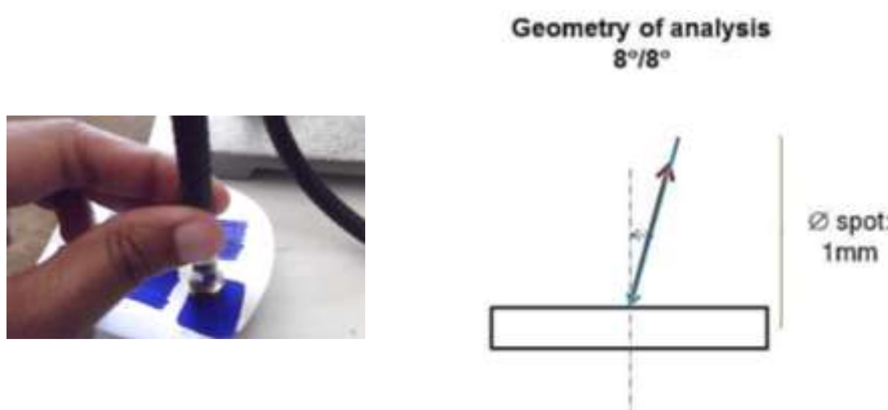


Figure 6.4. Geometry of analysis 8º/8º (red line: illumination; blue line: back-scattered radiation).

Both configurations: 0º/2x45º and 8º/8º were designed to remove the specular components from the reflectance measurements. Analyses were carried out placing *Spectralon®* disc under the sample in study.

- **UV-Vis-NIR laboratory DRS**

The modern watercolours reflectance spectra database also integrates spectra acquired by a UV-Vis-NIR double beam and double monochromator spectrophotometer for comparative purposes. Reflectance data were acquired in the 330-2500 nm range by using a UV--Vis-NIR double beam spectrophotometer and double monochromator Perkin-Elmer model lambda 1050 equipped with a 60 mm-diameter integrating sphere (Model integrating sphere – check) with a 0º/d geometry excluding the specular component (***Figure 6.5***).

Figure 6.5. IFAC-CNR UV-Vis-NIR double beam and double monochromator spectrophotometer (Perkin-Elmer Model Lambda 1050).

6.3. Results and discussion

- ***Violet colours***

As referred in ***Chapter 4***, cobalt violet designates both cobalt arsenate [$Co_3(AsO_4)_2$] and cobalt phosphate [$Co_3(PO_4)_2$]. The former can also exist in the form magnesium cobalt arsenate ($Mg_2Co(AsO_4)_2$)[Church 1915, 210; Corbeil *et al.* 2002].

The origin of the arsenate type (***Figure 6.6***) is unknown. Arthur Herbert Church, author of *The Chemistry of paints and painting* in his edition from 1915, pointed out some characteristics of this pigment. Church refers that cobalt arsenate was occasionally called *cobalt red*. He also refers that this pigment derived from the mineral erythrite or cobalt-bloom [$Co_3As_2O_8{\cdot}8H_2O$] or produced artificially. Moreover, Church refers that cobalt arsenate is a pigment *of a rather coarse grain which does not work smoothly as watercolour but has the advantage of complete stability in all vehicles* [Church 1915, 211]. M.J. Lefort included this pigment in his manual *Chimie des couleurs pour la peinture à l'eau et a l'huile* and reports the toxicity of this pigment (due to arsenic) [Lefort 1855, 18].

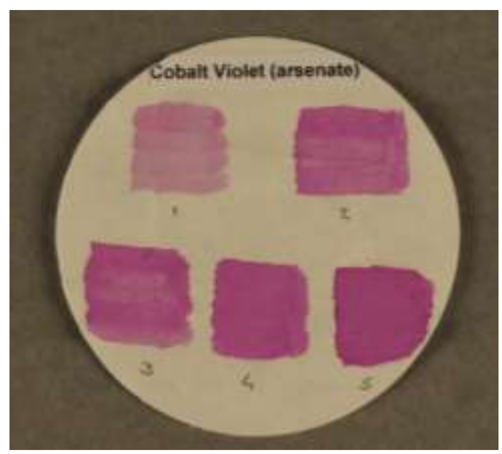


Figure 6.6. Example of mock-up prepared for the modern watercolour reflectance spectra database.

Phosphate variety of cobalt violet was discovered in 1859, by the chemist Salvetat who worked at the *Manufacture nationale de Sèvres*. His description of the preparation of this pigment can be found in the article entitled *Matieres minerals colorantes vertes et violettes* [Revue *L' Hachette & Co*. 1859, 725; Eastaugh *et al.* 2008, 123]. Salvetat's method for the production of cobalt phosphate consisted in the precipitation of a cobalt salt with sodium phosphate. By changing temperature during the heating, different colours could be obtained [Eastaugh *et al.* 2008, 123].

The arsenate form is lighter compared to the phosphate's one [Carlyle 2001, 531]. During the 1890s, cobalt violet was presented in both W&N and Reeves catalogues [Carlyle 2001, 503].

Although this pigment was reported at the time as an unusual and expensive one, the arsenate form was found, for instance, in watercolour paintings by Paul Cézanne (1839-1906] from late 1890s-early 1900s [Zieske 1995].

In the following pages are presented the reflectance spectra obtained for cobalt violet in the arsenate form using FORS with the probe-head geometries 0º/2x45º and 8º/8º and using DRS (***Figures 6.7 and 6.8***).

In the three sets of reflectance spectra, the spectral behaviour is very similar. As discussed in ***Chapter 5***, the reflectance peaks are connected with the colour of the surface in analysis. The absorption bands are related with the mechanisms of electronic transitions occurring, giving the indication of the pigment. It is observable a decrease of the reflectance factor with the increase of the concentration of pigment, i.e. the paint mock-up more diluted show, in general, the greatest reflectance factor.

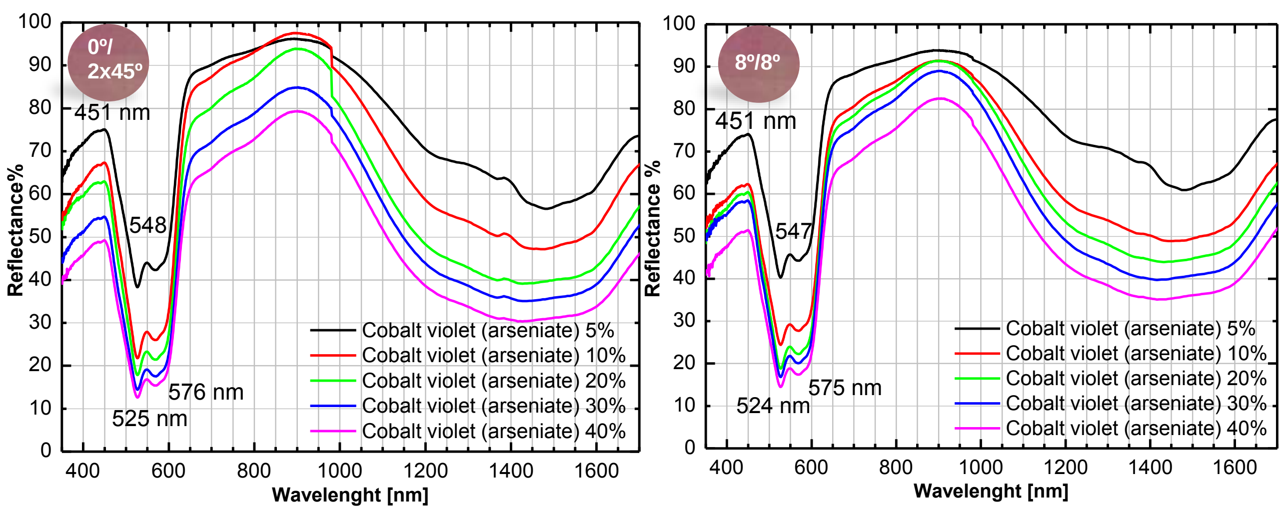


Figure 6.7. FORS spectra of cobalt violet (arsenate) watercolour paint:
On the left: geometry of analysis 0º/2x45º. *On the right:* geometry of analysis 8º/8º.

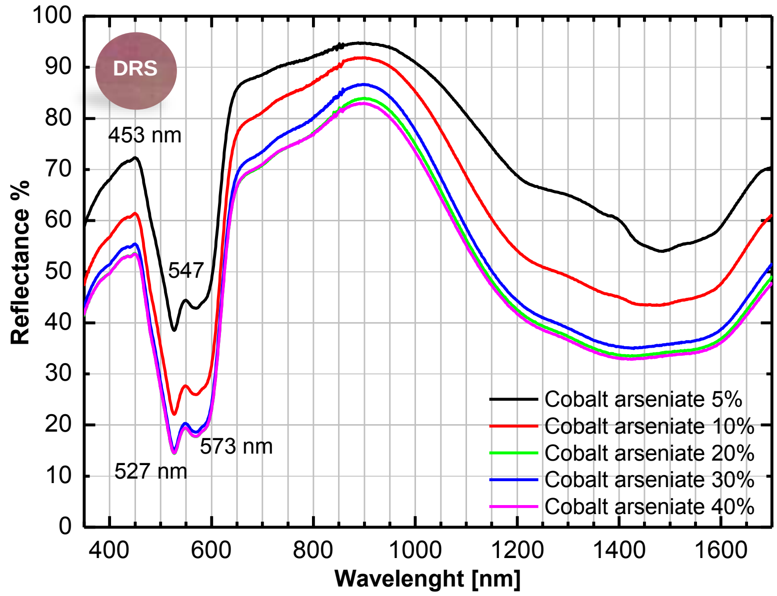


Figure 6.8. DRS spectra of cobalt violet (arsenate) watercolour paint.

All reflectance spectra presented in ***Figures 6.7 and 6.8*** show absorption bands located at ca. 530 and 580 nm, caused by the *d-d* transitions in cobalt-ion [Bacci and Picollo 1996; Bacci 2000, 342]. These spectra also show a strong influence of paper signal in the NIR region and for this reason the total range is not totally presented, as already explained in ***Chapter 4***. Due to the influence of paper, the three absorption sub-bands characteristic of this pigment between ca. 1200-1500 nm are not observed.

It is worth to refer that FORS spectra show good resolution comparing with the results obtained with DRS. This fact represents another advantage of the technique.

Since the three methodologies show similar results between them for all pigments in study, only the reflectance spectra obtained using FORS with the probe-head geometry 8º/8º will be presented and discussed in the following text. Moreover, this was the methodology followed in the analysis carried out in *La Légende de Saint Julien l'Hospitalier*. The spectra obtained using FORS with the probe-head geometry 0º/2x45º and DRS can be consulted at the website of the database [*see* http://mowcres.ifac.cnr.it.] and in ***Appendix A6.4***.

Regarding cobalt violet (phosphate), the obtained reflectance spectra present an intense absorption band in the 500-650 nm range (***Figure 6.9***) [*see also* ***Appendix A6.5***]. For the determination of the location of the characteristic absorption bands of this pigment, the acquired reflectance spectra were expressed in both Kubelka-Munk and log (1/R) functions for comparison (***Figure 6.10***). Despite de characteristics of the samples (the internal inhomogeneities of paper itself and of the watercolour paint layers, which differs significantly from the propagation of light in a homogeneous sample), the results obtained show that both functions allow locating the absorption bands. However, through Kubelka-Munk function, the shape of such bands is better delineated making easier the task. This fact is clearer in the cases of the samples were the paint layer is more saturated. For this reason, Kubelka-Munk function will be adopted in the further spectra presented, for the determination of the absorption bands.

The bands identified in Cobalt violet (phosphate) regard to the to the *d-d* transitions in cobalt-ion as in the case of cobalt violet in the arsenate form [Bacci and Picollo 1996; Bacci 2000, 342].

The reflectance spectra obtained for both cobalt violet pigments studied also indicate that the arsenate form has a reflectance maximum at ca. 453 nm located in the violet-blue region of the visible spectrum, whereas the phosphate form presents a reflectance maximum at ca. 446 nm and thus located at the violet region of the visible spectrum.

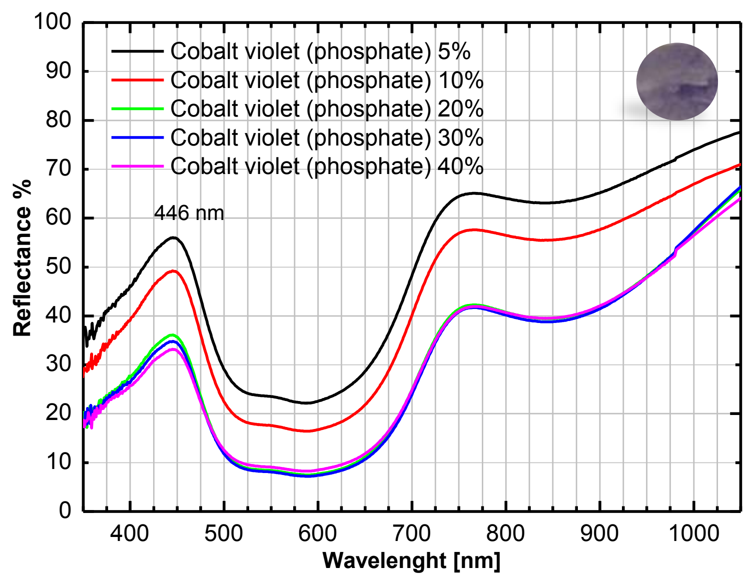


Figure 6.9. FORS spectra of cobalt violet (phosphate) watercolour paint (geometry of analysis: 8º/8º).

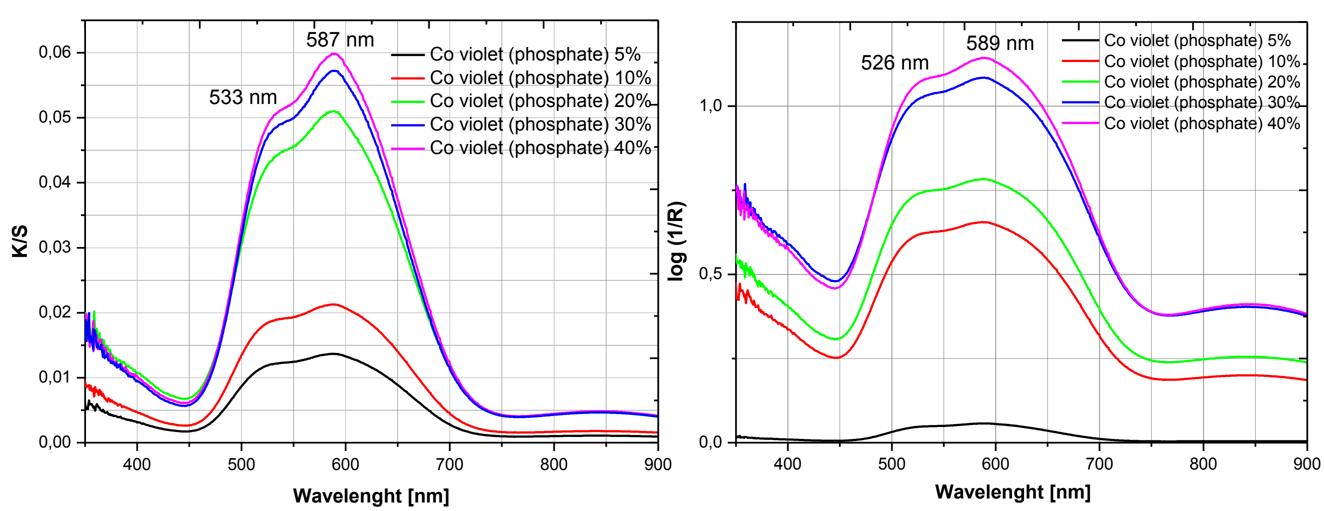


Figure 6.10. Cobalt violet (phosphate) watercolour paint:
On the left: Kubelka-Munk function. *On the right:* Apparent absorbance [log (1/R)].

- ***Blue colours***

The origin of cerulean blue [cobalt stannate, $CoO \cdot nSnO_2$] is not clear. However its production is connected somehow with Andreas Höpfner who produced, in 1789, a blue colour that became known as *Höpfner blue*. The pigment seems to have been forgotten until 1850s-60s and reintroduced later, probably by *Rowney & Co* around 1860 in England, under the name *ceruleum* [Carlyle 2001, 472; Eastaugh *et al.* 2008, 96]. The catalogue of W&N from 1896 presents Cerulean blue as a pigment used for watercolour paint and classified as *permanent colour*[298] [Catalogue W&N 1896, xxxi].

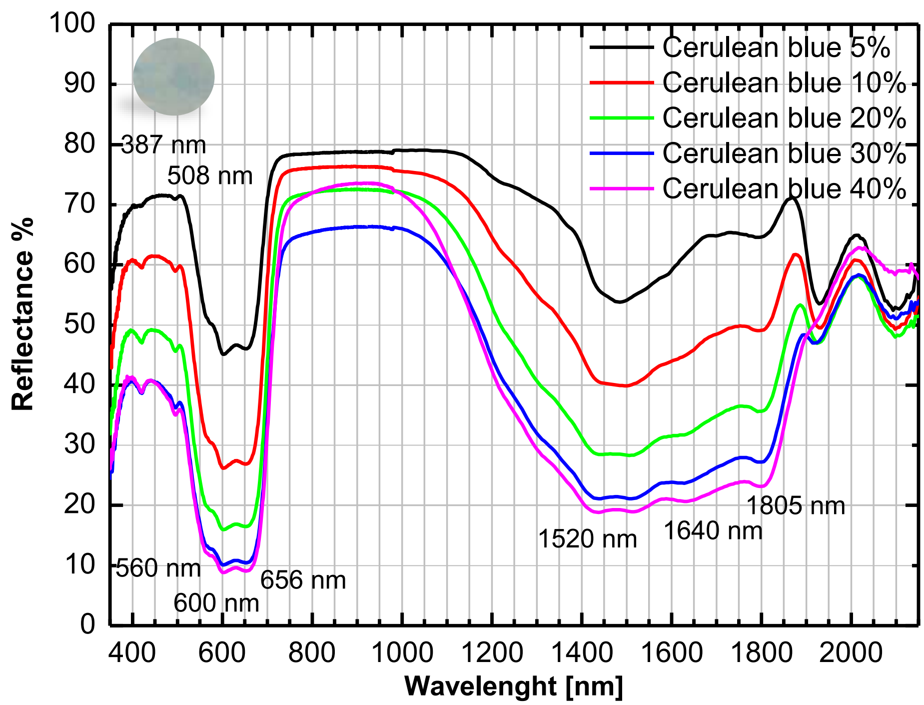


Figure 6.11. FORS spectra of cerulean blue watercolour paint (geometry of analysis: 8º/8º).

The reflectance spectra presented show three absorbance bands between 560 and 660 nm caused by the ligand field transitions between *d-d* orbitals of Co (II) ion with a pseudo-tetrahedral coordination. The influence of these transitions is also visible in the NIR regions in the three absorption sub-bands observable in the 1500-1810 nm are not clearly perceptible, because of the strong influence of paper (***Figure 6.11***) [Bacci *et al.* 2009].

[298] A *permanent colour* resists the prolonged action of light and do not change its hue easily [Cf. Church 1915, 257].

Cobalt blue (cobalt aluminium oxide, $CoO{\cdot}Al_2O_3$) was discovered by the French chemist Louis--Jacques Thénard in 1802 [Delamare 2007, 237; Roy 2007, 151]. Thénard published his findings about the pigment production in *Journal des Mines* in 1802-1803 [Thénard 1803]. The pigment started being commercialised very soon after its first synthesis [Delamare 2007, 239; Roy 2007, 152]. The presence of cobalt phosphate or cobalt arsenate in cobalt blue composition provides the characteristic violet tone of this blue pigment [Roy 2007, 155].

According to Hurst (1913), cited by Ashok Roy, this pigment was considered at the time *too expensive for general use in painting, but is largely used by artists, especially as watercolour, as it works better in water than in oil* [Roy 2007, 155]. This pigment was listed by W&N, Reeves and Rowney in the earliest catalogues from these companies since 19th century [Carlyle 2001, 471]. In the catalogue W&N from ca. 1896, cobalt blue was listed as a quite permanent pigment for watercolour painting [Catalogue W&N 1896, xxxi].

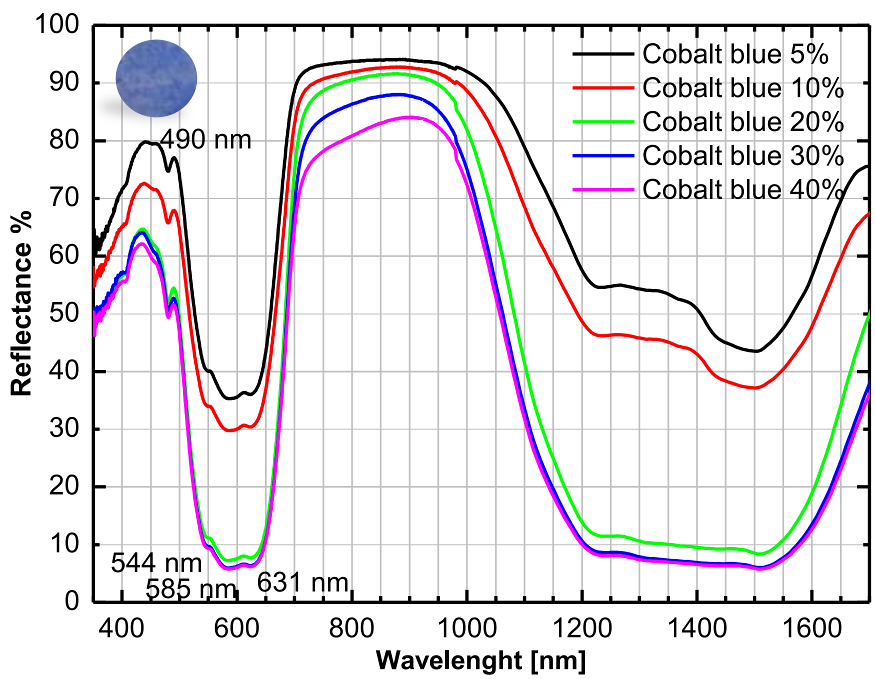


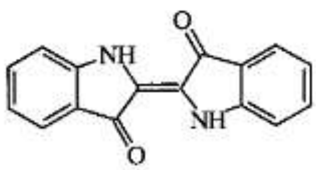
Figure 6.12. FORS spectra of cobalt blue watercolour paint (geometry of analysis: 8º/8º).

The reflectance spectra of cobalt blue show reflectance maximum at ca. 450 nm related with strong absorption band between 550-650 nm which is subdivided into three sub-bands. This band occurs due to a ligand-field transition between *d-d* orbitals of Co (II) with a pseudo-tetrahedral coordination in the aluminum (III) oxide lattice. This coordination of the cobalt ion is responsible for the strong absorption band observed between the 1200-1500 nm ranges, also divided into three sub-bands. The sharp and weak absorption band around 490 nm may be caused by a spin forbidden quartet-doublet transition (***Figure 6.12***) [Bacci and Picollo 1996; Bacci *et al.* 2009].

Indigo is a blue pigment and dye derived from the leaves of various *Indigofera* species. The chemical formula may be described as 2-(1,3- dihydro-3-oxo-2H-indol-2-ylidene)-1,2-dihydro- 3H-indol-3-one [Eastaugh *et al.* 2008, 194]. Its use was identified in Roman wall painting in the first century AD and Mayan pottery. In the middle ages, indigo was profusely used in particular mixed with several white pigments [Eastaugh *et al.* 2008, 195].

The synthetic method of production of indigo was discovered by Baeyer and Emmerling in 1870. In 1897, it started being commercialised as indigo pure [Eastaugh *et al.* 2008, 195].

Indigo is listed in the catalogue W&N from ca. 1896 only as a pigment used for watercolour paint and classified as *fugitive colour*[299] [Catalogue W&N 1896, xxxi; Carlyle 2001, 476].



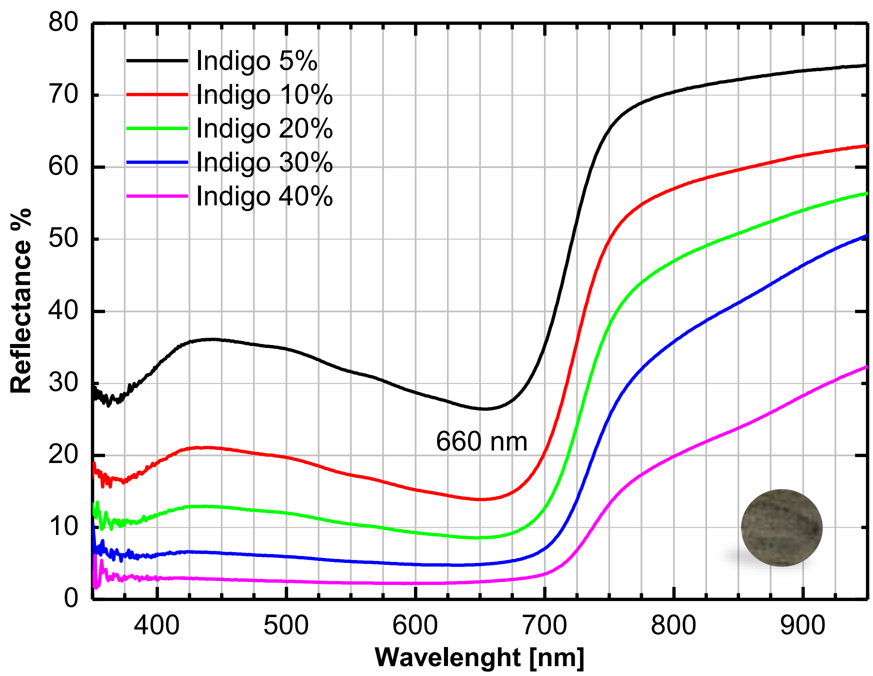


Figure 6.13. *On the left:* A molecular structure of Indigo [Miliani *et al.* 1998]. *On the right:* FORS spectra of indigo watercolour paint (geometry of analysis: 8º/8º).

The characteristic broad and asymmetric absorption band of indigo is observed between ca. 420 and 730 nm. It can be assigned to the lowest energy π-π^* electronic transition, from the highest occupied molecular orbital (HOMO) to the lowest unoccupied molecular orbital (LUMO) (***Figure 6.13***) [Leona *et al.* 2004].

The spectra of indigo corresponding to highest dilutions of the watercolour paint (5%, 10% and 20%) show a maximum of absorbance at ca. 660 nm and a reflectance peak at ca. 430 nm [Boselli 2010, 152; Aceto *et al.* 2014].

[299] A *fugitive colour* does not resist the prolonged action of light. According to Church, *this rich and transparent blue is, unfortunately gradually oxidised and browned when exposed to light. In thin washes of watercolour it disappears rapidly in the sun's ray, much more slowly when submitted to diffuse daylight* [Church 1915, 243].

The "accidental" discovery by Diesbach in Berlin in 1704 of Prussian blue, an iron (III) hexacyanoferrate [$Fe_4[Fe(CN)_6]_3 \cdot 14H_2O$ or $KFe[Fe(CN)_6 \cdot H_2O]$] can be considered as one of the first synthesis of a modern pigment [Berrie 1997, 191; Eastaugh *et al.* 2008, 309; Delamare 2007, 185].

As referred by Church, *Prussian blue is a transparent colour of great force and richness and works well in oil as well as in water*. This author also mentions the problem of colour fading occurring in this pigment from the exposure to light. This fact increases the tendency of the pigment to turn green [Church 1915, 239].

In the late 19th century, Prussian blue used to be commercialised under the name *Antwerp blue* or *Chinese blue* by W&N and Reeves [Carlyle 2001, 475].

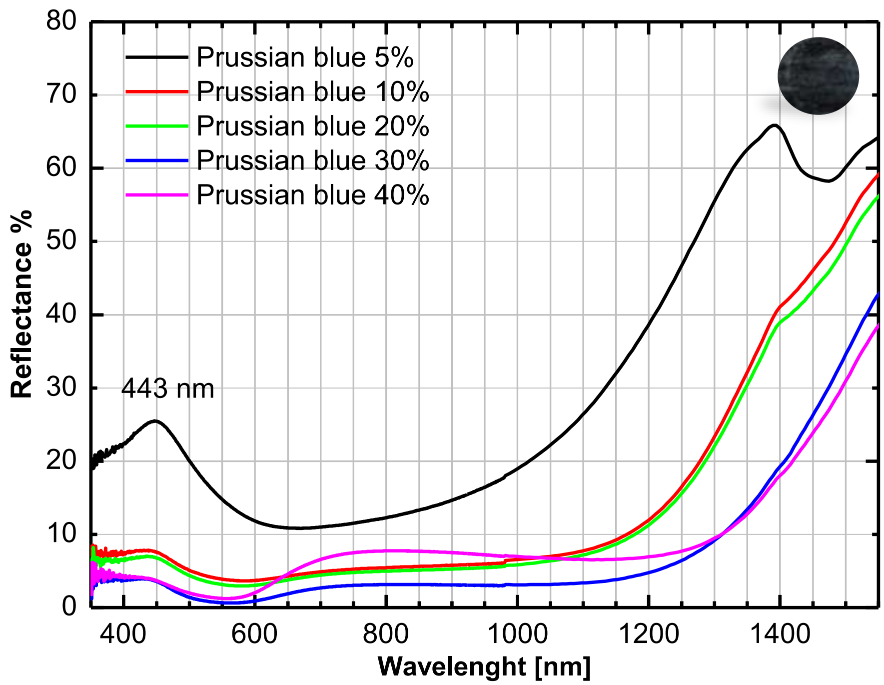


Figure 6.14. FORS spectra of Prussian blue watercolour paint (geometry of analysis: 8º/8º).

Prussian blue reflectance spectra (***Figure 6.14***) present a reflectance peak at ca. 443 nm which is more evident in the spectrum corresponding to the more diluted mock-up (5%). Its intense dark colour is mirrored in the low reflectance values observed in the Vis range in mock-ups 10% to 40% which seem analogous with those of a black pigment. The pigment is characterised by a broad absorption band located between ca. 600 and 1000 nm that can be attributed to a homonuclear intervalence charge transfer transition between the ions Fe (II) and Fe (III) [Bacci *et al.* 2009]. This blue pigment usually presents characteristic features in the NIR range. However, in watercolour painting on paper, due to the strong signal of paper in that region those pigment features are masked and not detected [*see* ***Appendix A6.4***].

Ultramarine blue, a complex with sulphur in a sodium aluminosilicate matrix [$Na_{8-10}(Al_6Si_6O_{24})S_{2-4}$] became the synthetic and less expensive variant of lazurite - the natural form of ultramarine extract from the Persian rock type lapis lazuli [Plesters 1993, 55; Eastaugh *et al.* 2008, 209].

The invention of the manufacture of this pigment is attributed to Jean Baptiste Guimet in 1828. Guimet won the award for the development of a workable method for producing ultramarine. This prize was offered by the *Société d'Encouragement pour l'Industrie Nationale in France* [Eastaugh *et al.* 2008, 375].

In the catalogues from the 19th century from W&N, Rowney and Reeves, Ultramarine blue is presented under the names *French Ultramarine*, *New Blue*, *French blue* or *Permanent blue* [Carlyle 2001, 473].

As referred by Church, artificial ultramarine, when properly prepared, is permanent both in water and oil [Church 1915, 231].

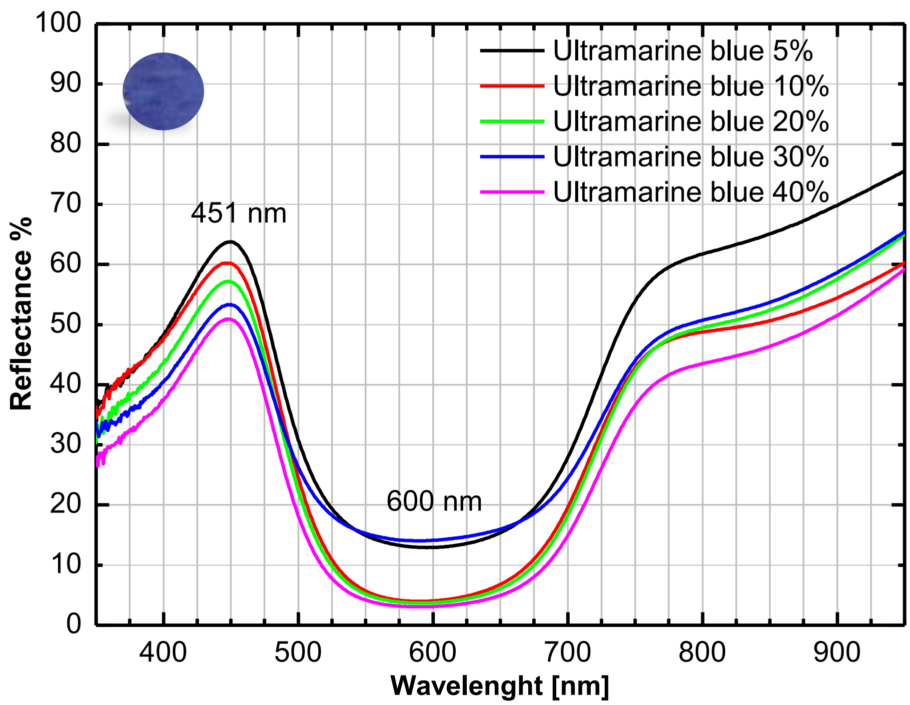


Figure 6.15. FORS spectra of ultramarine blue watercolour paint (geometry of analysis: 8º/8º).

The spectra obtained (***Figure 6.15***) show a strong absorption band centered at 600 nm. It is assigned to the charge transfer transition between the S_2^- and S_3^- anions present in the lattice of the complex [Bacci *et al.* 2009; Aceto *et al.* 2013]. Moreover, the reflectance peak observed at ca. 450 nm is characteristic of a synthetic pigment [Aceto *et al.* 2013].

- ***Green colours***

Green chrome oxide (Cr_2O_3) was considered as an excellent product in colour despite its expensive process [Church 1915, 215]

It is not known when the green chrome oxide was introduced. However, it was found in a painting by Turner from 1812 and a sample of this colour made by the British colourman George Field was entered in his *Practical Journal* in 1809 and after in 1815 [Eastaugh *et al.* 2008, 102].

According to Church, green chrome oxide was available in all processes of painting [Church 1915, 216]. W&N listed the pigment for the first time in the c. 1840 catalogue [Carlyle 2001, 492]. A source from W&N refers that chrome oxide green in watercolour is *[…] a deep toned green, bright but not vivide […]. Is extremely permanent, but does not wash well in flat tints* [The handbook W&N n.d., 31].

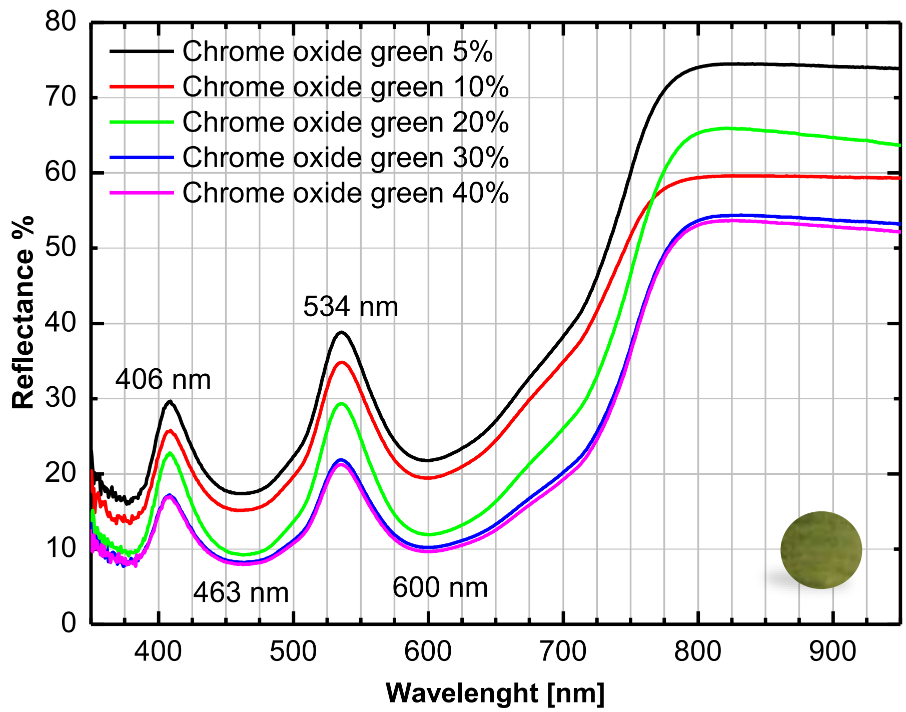


Figure 6.16. FORS spectra of chrome oxide green watercolour paint (geometry of analysis: 8º/8º).

Chrome oxide green shows two reflectance peaks located at ca. 406 nm and 534 nm (***Figure 6.16***). The absorption bands are located at ca. 463 nm and 600 nm. These bands occur due to *d-d* electronic transitions related with chromium (III) in an octahedral coordination [Bacci 2000, 342; Boselli 2010, 167].

Viridian is a hydrated chromium oxide [chromium (III) oxide dihydrate ($Cr_2O_3 \cdot 2H_2O$) [Eastaugh *et al.* 2008, 391]. This pigment is usually referred as the transparent form of chromium oxide. It was developed by Pannetier and Binet around 1838 when they began to make beautiful chromium green by means of a secret recipe. Some years later, Guignet discovered and patented the process in 1859 [Church 1915, 216; Eastaugh *et al.* 2008, 391].

In France, Viridian is denominated *vert émeraud*. This fact may create some confusion with the poisonous copper and arsenic based pigment known as emerald green (Schweinfurt green) [Carlyle 2001, 493; Eastaugh *et al.* 2008, 149].

Viridian green was reported to be used in all different painting media [Church 1915, 217]. In England, this pigment was first introduced by W&N in 1864 [Carlyle 2001, 493].

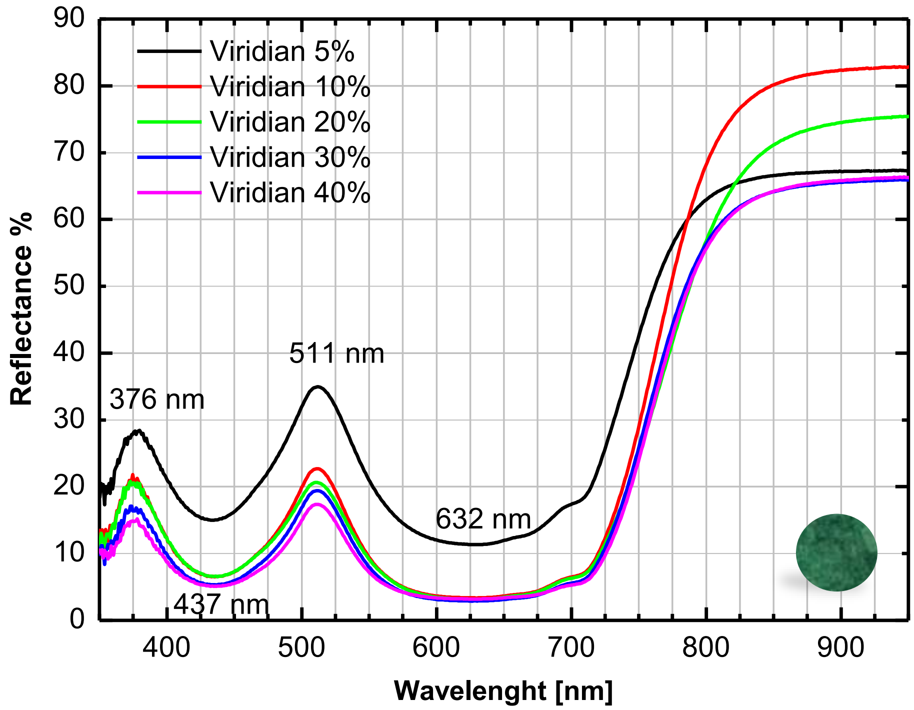


Figure 6.17. FORS spectra of viridian watercolour paint (geometry of analysis: 8º/8º).

In comparison with Chrome oxide green, Viridian presents a similar spectral behaviour. However, the reflectance peaks are shifted respect to the previous case, being located at ca. 376 and 511 nm (***Figure 6.17***). The absorption bands are located at ca. 437 nm and 632 nm and are also caused by the same electronic transitions [Bacci 2000, 342; Boselli 2010, 167].

Cobalt green is a cobalt oxide-zinc oxide compound (CoO·nZnO). It can be said to be similar to cobalt blue except for the fact that zinc oxide partially or completely replaces the aluminium oxide [Eastaugh *et al.* 2008, 113].

The opinions concerning this pigment are diverging. According to the researcher Leslie Carlyle, Salter (1869) mentioned that cobalt green was chemically good but artistically bad and *deficient in body and power*. Salter also mentioned the contrary opinion of Church (1890), who stated that the pigment was *chemically and artistically perfect* [Carlyle 2001, 492].

In 19th century, the catalogues of W&N (1882) and Reeves (1892) listed this pigment [Carlyle 2001, 491].

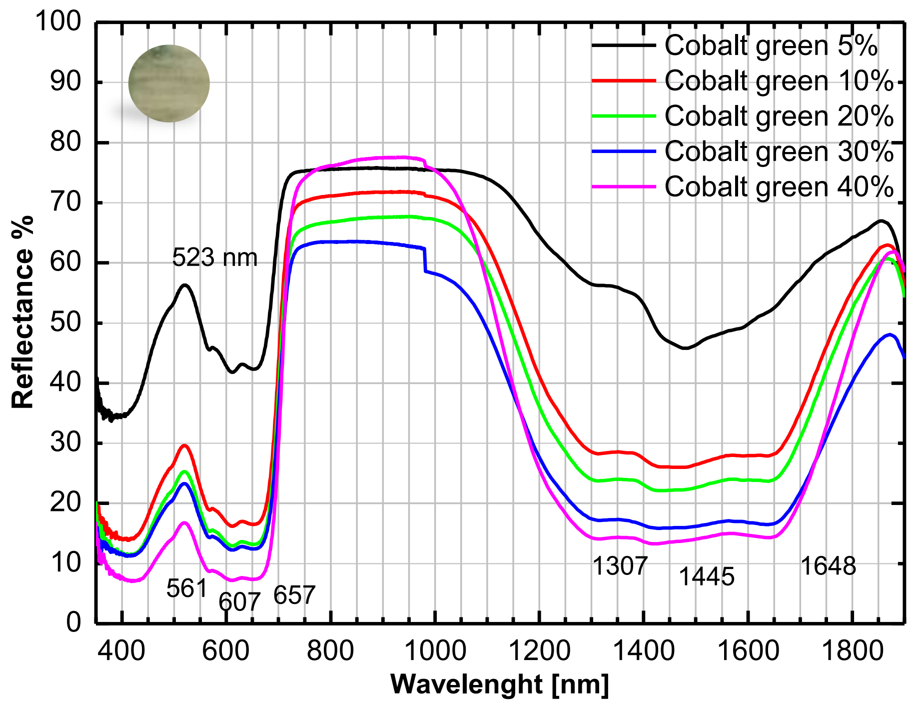


Figure 6.18. FORS spectra of cobalt green watercolour paint (geometry of analysis: 8º/8º).

Cobalt green reflectance spectra present a strong absorption band between ca. 520 and 660 nm which is divided in three sub-bands at ca. 561, 607 and 657 nm. Another strong absorption band is observed in the NIR region, sub-divided at ca. 1306, 1440 and 1655 nm. Both absorption bands are related with the transitions *d-d* of the Co (II) ion in tetrahedral coordination (***Figure 6.18***) [Miliani *et al.* 2007].

In what regards the mock-up 5%, the strong influence of paper is observed in the NIR region which does not allow the observation of the band between ca. 1300-1700 nm. This fact is related with the high dilution of the paint layer and the penetration of IR radiation observed in that range.

Schweinfurt green (emerald green) is a copper (II)-acetoarsenate [$Cu(C_2H_3O_2)_2 \bullet 3Cu(AsO_2)_2$].

The first synthesis is accredited to two sources, both from the year 1814: First, to the paint manufacturer Wilhelm Sattler and the pharmacist Friedrich Russ who made reacting verdigris with arsenic compounds. Second, to Ignaz von Mitis who produced this pigment, that same year in Vienna [Eastaugh *et al.* 2008, 149]. It is a very toxic pigment [Church 1915, 220].

In the catalogue of W&N ca. 1896, Schweinfurt green is listed as moderately permanent colour for watercolour painting [Catalogue W&N 1896, xxxix].

A source also from W&N refers to this pigment in watercolour as *a vivid light green, immediately attracting the eye to any part of the picture in which it may be used* [W&N n.d., 30].

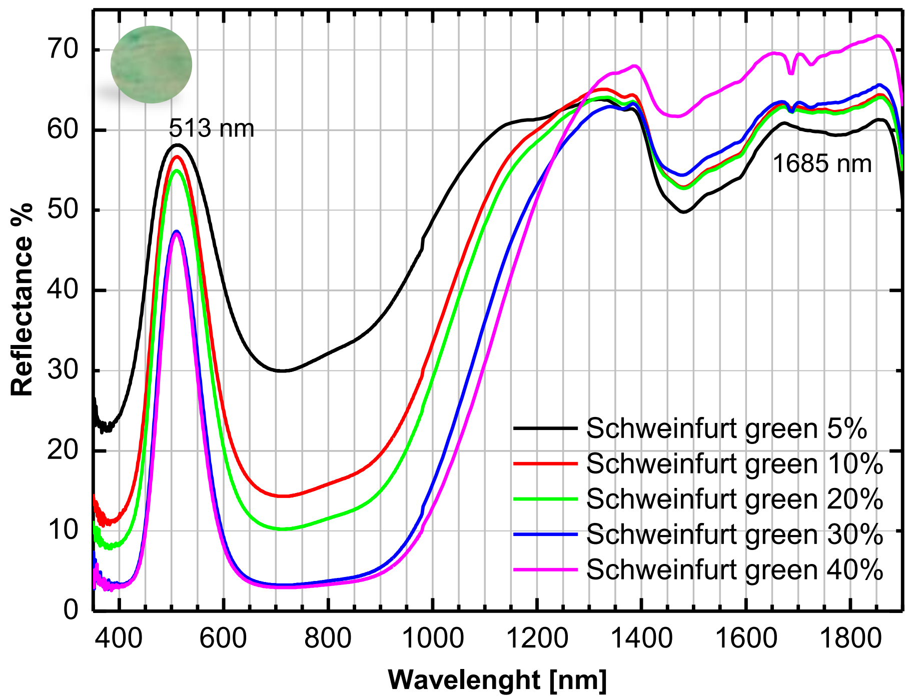


Figure 6.19. FORS spectra of Schweinfurt green watercolour paint (geometry of analysis: 8º/8º).

The reflectance spectra of Schweinfurt green (***Figure 6.19***) present a broad absorption band from ca. 650 nm – 1000nm related with the ligand-field transitions *d-d* in copper (II) ion. At ca. 1685 nm and 1730, the spectra concerning mock-ups 30% and 40 % show an absorption band referred to the first C–H overtones of -CH_3 and -CH_2, respectively. The mock-ups where the paint layer are more diluted do not show this band due to the thinner paint layers and strong influence of paper in the NIR region [Shimoyama *et al.* 1998; Boselli 2010, 148].

- ***Yellow and brown colours***

Yellow ochre and raw sienna are yellow pigments which main compound present in their composition is the iron oxide hydroxide goethite (α-FeOOH) [Helwig 2007, 40].

Yellow ochre is one of the most ancient pigments used in History by the Egyptians, the Greeks and the Romans [Church 1915, 159].

Terra di Sienna is a yellow earth originating near Siena that did not appear in English or Italian treatises until the second half of the 18th century [Helwig 2007, 45].

There are no relevant differences between yellow ochre and raw sienna. Raw Sienna is reported to contain more iron oxide than yellow ochre and their transparency may be due to the small particle size of goethite in these pigments. Raw Sienna also contains a small percentage of manganese oxides and eventually silicates and aluminates [Helwig 2007, 61; Eastaugh *et al.* 2008, 339]. Yellow ochre also contains in its composition alumina-silicate, quartz and calcium compounds [Elias *et al.* 2006; Helwig 2007, 40].

In the catalogue of W&N ca. 1896, yellow ochre and raw sienna are listed as permanent colours for watercolour painting [Catalogue W&N 1896, xxxviii]. A source from W&N pointed out raw sienna as the *more transparent in its tints than any of the ochres* [W&N n.d., 25].

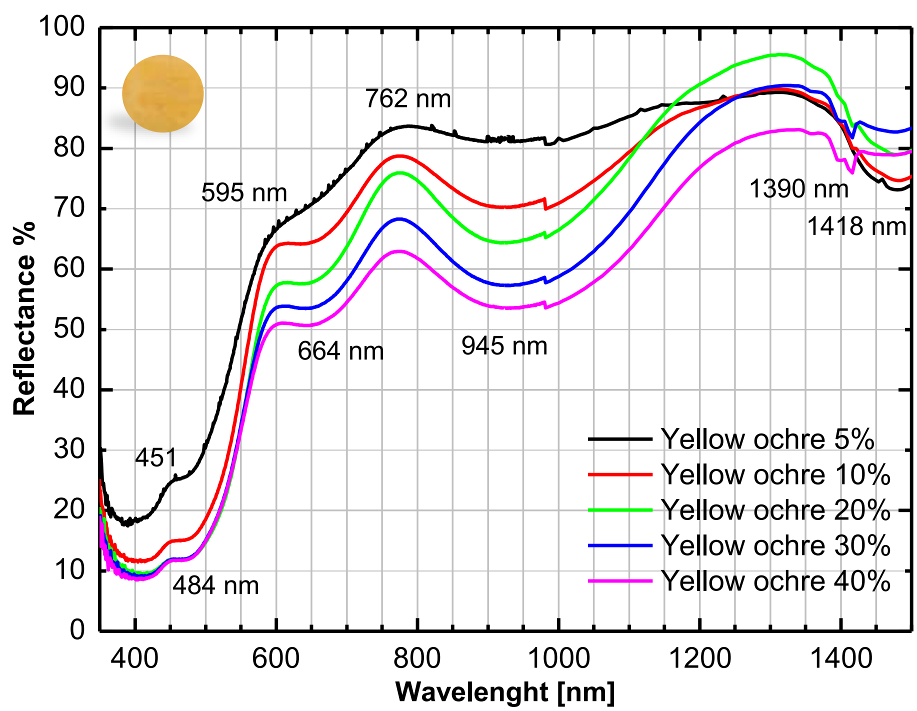


Figure 6.20. FORS spectra of yellow ochre watercolour paint (geometry of analysis: 8º/8º).

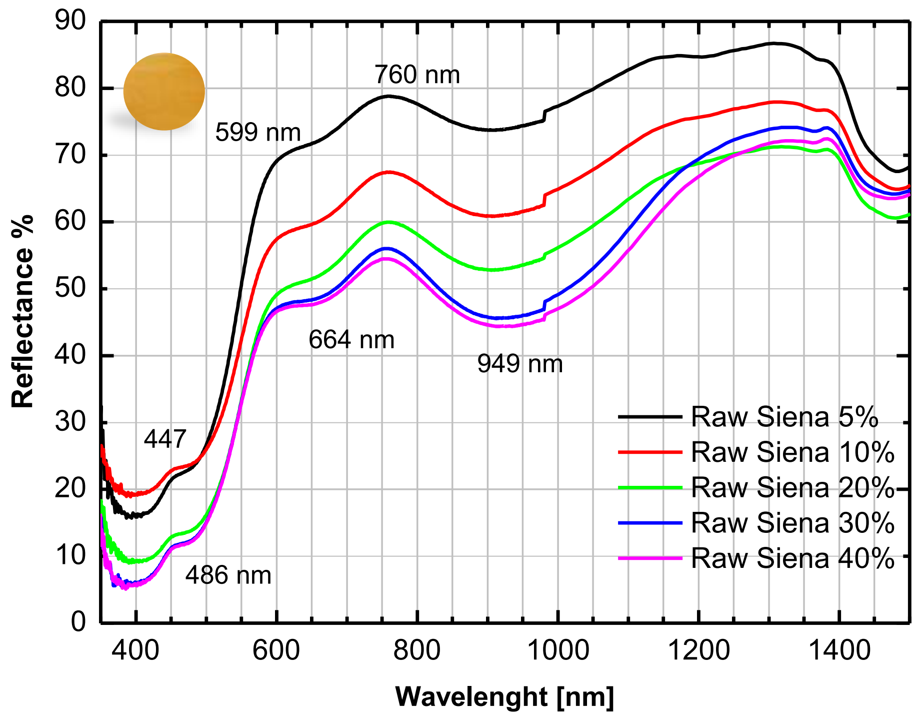


Figure 6.21. FORS spectra of raw sienna watercolour paint (geometry of analysis: 8º/8º).

FORS spectra of both pigments (***Figures 6.20 and 6.21***) show reflectance peaks at ca. 450, 600 and 760 nm. The absorption bands located at ca. 490 nm, 660 nm and 950 nm are due to the *d-d* ligand field transitions of Fe(III) ions, characteristic of goethite [α-FeO(OH)] [Bacci 2000, 342; Boselli 2010, 161; Aceto *et al.* 2014].

In yellow ochre spectra, at ca. 1390 and 1418 nm show two absorption bands for the mock-ups 30% and 40%. The possible assignment may be attributed to the first overtones of OH-stretching fundamental modes associated to hydroxyl group from kaolinite [$Al_4Si_4O_{10}(OH)_8$] [Viscarra Rossel *et al.* 2006; Picollo *et al.* 2007]. The mock-ups where the paint layer are more diluted do not show these bands caused by the thinner paint layers and strong influence of paper in the NIR region.

Burnt sienna is the calcined, oxidised equivalent of raw sienna. It is composed of a mixture of iron oxides, silica and clay. In the catalogue of W&N ca. 1896, burnt sienna is listed as permanent colour for watercolour painting [Catalogue W&N 1896, xxxix]. The reflectance spectra of this pigment (***Figure 6.22***) show a reflectance peak located at ca. 750-760 nm and an absorption band centred at ca. 850 nm due to *d-d* transitions of Fe(III) ions [Bacci 2000, 342; Boselli 2010, 144; Aceto *et al.* 2014].

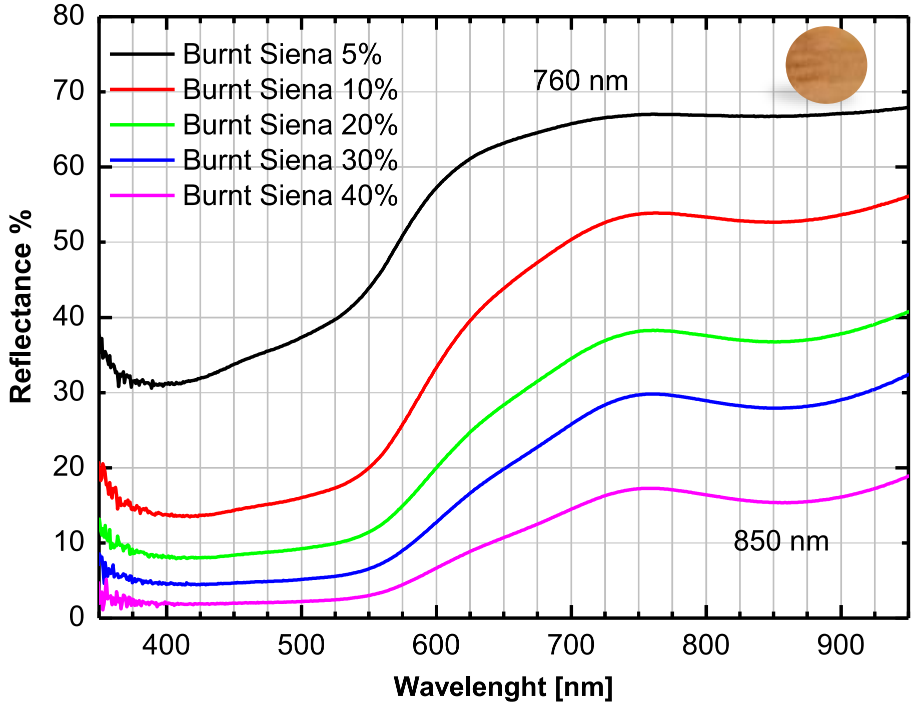


Figure 6.22. FORS spectra of burnt sienna watercolour paint (geometry of analysis: 8º/8º).

The element chromium was discovered in 1797 by Vauquelin and in 1809 he synthesised for the first time chrome yellow [lead chromate ($PbCrO_4$)] [Otero *et al.* 2012].

Lead chromate started being offered by W&N, Rowney and Reeves in the middle of the 19th century [Carlyle 2001, 521]. Church refers that *chromates of lead are peculiarly liable to change and are quite unfitted for use in tempera or watercolour painting* [Church 1915, 183]. However, in the catalogue of W&N ca. 1896, chrome yellow and some varieties of this pigment are listed as moderately permanent colour for watercolour painting[300] [Catalogue W&N 1896, xxxix].

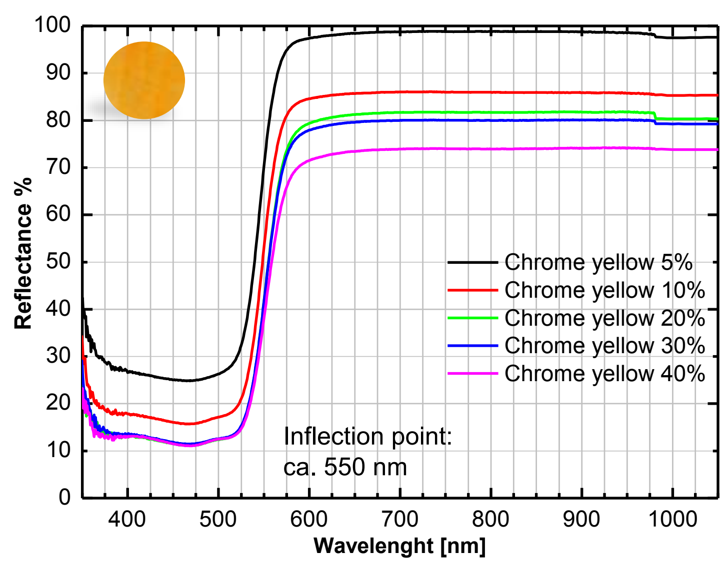


Figure 6.23. FORS spectra of chrome yellow watercolour paint (geometry of analysis: 8º/8º).

[300]Concerning these pigments, in the catalogue W&N 1896 it can be read: *These [pigments] offer a good resistance to the combined action of light, oxygen and moisture but are liable to darken under the influence of sulphureted hydrogen* [Catalogue W&N 1896, xxxix].

Reflectance spectra of chrome yellow (***Figure 6.23***) show a strong absorbance band centred at ca. 460 nm due to ligand field transitions concerning the Cr(VI) ion [Nassau 1987]. The spectra also present an inflection point at ca. 550 nm [*see* ***Appendix A6.6***].

Naples yellow is a lead antimonite ($Pb_2Sb_2O_7$). Vincent van Gogh referred to this pigment as making part of his palette in both oil and watercolour paint[301]. This is a toxic pigment [Fielder and Bayard 1986, 67]. Naples yellow is also listed in the catalogue of W&N c. 1896 as a permanent colour for watercolour paint. However, the composition of the paint consisted in a combination of zinc white and cadmium yellow [Carlyle 2001, 529].

Church reports that Naples yellow use as watercolour has some drawbacks: *In watercolour painting genuine Naples yellow [lead antimonite] is quite inadmissible, for it blackness rapidly, but irregularly, in the presence of mere traces of sulphur compounds* [Church 1915, 179].

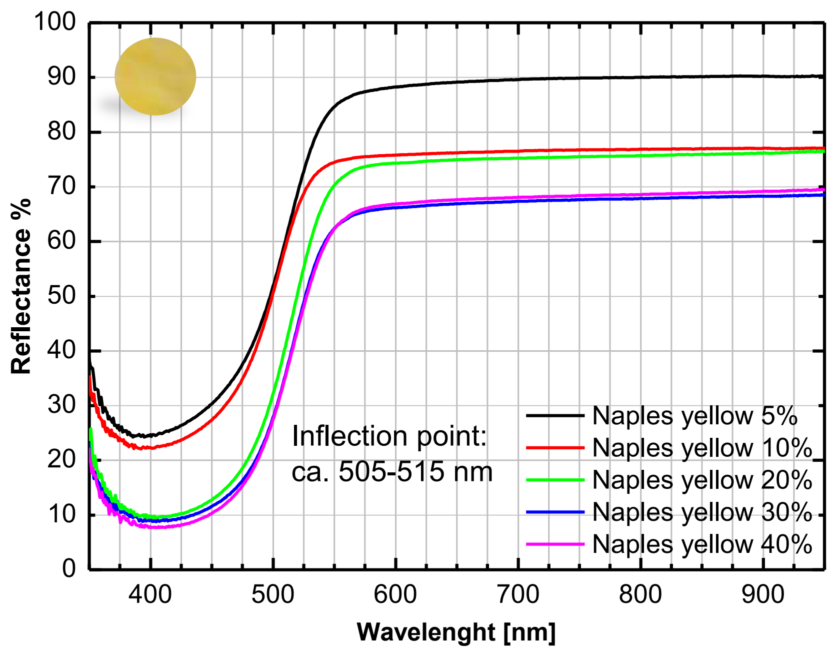


Figure 6.24. FORS spectra of Naples yellow watercolour paint (geometry of analysis: 8º/8º).

Lead antimonite spectrum (***Figure 6.24***) show a S-shape behaviour with and inflection point between ca. 505 nm in the case of the most diluted mock-ups (5% and 10%) and 515 nm in the other three cases (20-40%)[302] [*see* ***Appendix A6.6***].

[301]In a letter to his brother Theo dated The Hague, August 5, 1882, Van Gogh stated: *[…] but you will understand that I limited myself to the simple colours in watercolour as well as in oil: ochre (red-yellow-brown), cobalt and Prussian blue, Naples yellow, sienna, black and white, completed with some smaller tubes of carmine, sepia, vermilion, ultramarine, gamboge* [Van Gogh 1882].
[302]Cf. Aceto *et al.* 2014.

- ***Cadmium-based colours***

The element cadmium was discovered in 1817 by Stromeyer [Church 1915, 162; Fielder and Bayard 1986, 67]. In 1819, Stromeyer discovered cadmium sulphide (CdS), known as cadmium yellow and started recommending it as an artists' pigment [Fielder and Bayard 1986, 67].

As reported by Church, in the early 20th century, cadmium yellow was available in different hues and tints from the palest lemon cadmium to the fiery orange-red, according to the process of pigment manufacture. Moreover, in what regards the production of the orange-yellow variety, Church referred: *[...] when very finely ground becomes less red and more inclined to yellow*. Moreover, it is also mentioned the high stability of the pigment in both oil and watercolour [Church 1915, 162].

Cadmium yellow started being listed in the catalogues of W&N, Reeves and Rowney in the middle of the 19th century [Carlyle 2001, 524]. In the catalogue of W&N c. 1896, cadmium yellow and cadmium orange are presented as different varieties of sulphide of cadmium and permanent colours for watercolour painting [Catalogue W&N 1896, xxxviii]. Cadmium orange in this context was assumed as *deep* variety of cadmium yellow [Carlyle 2001, 524].

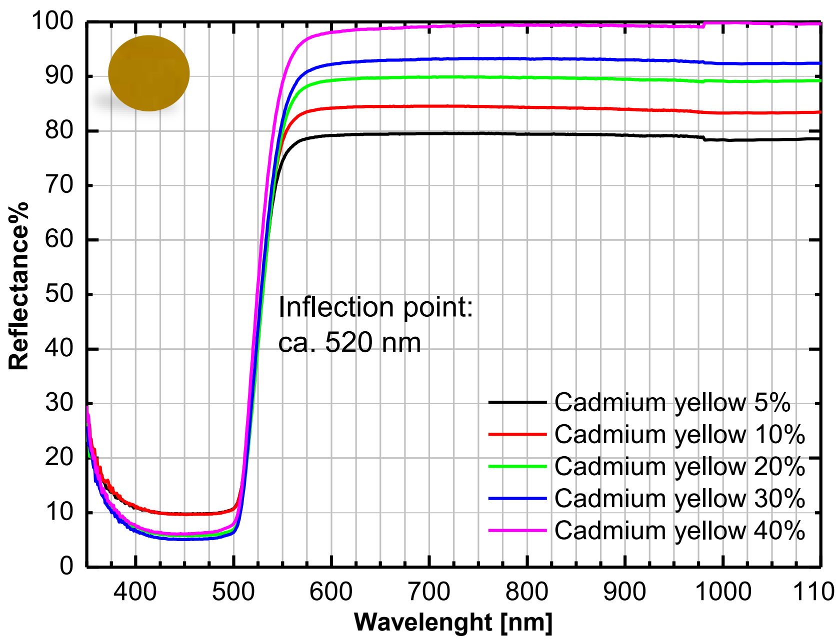


Figure 6.25. FORS spectra of cadmium yellow watercolour paint (geometry of analysis: 8º/8º).

The reflectance spectra obtained for this pigment show an increase of the absorption bands for the less diluted mock-ups (20-40%). Those bands are centred at ca. 450 nm (***Figure 6.25***). Since cadmium yellow is a semiconductor, the S-type band with an inflection at ca. 520 nm is caused by a band-to-band transition in cadmium [*see* ***Appendix 6.6***] [Fielder and Bayard 1986, 67; Boselli 2010, 145]. In this case, reflectance increases with the sample's saturation (the surfaces becomes also brighter/glow).

In what concerns cadmium red and cadmium orange, Church referred that both pigments possess *very full and glowing hues* and *they work well as oil and watercolours* [Church 1915, 167].

According to Eastaugh *et al.* cadmium selenide or cadmium sulphide pigments were patent in 1892 and first commercialised in 1910 [Eastaugh *et al.* 2008, 70]. In fact, this pigment is not listed in the catalogue of W&N c. 1896.

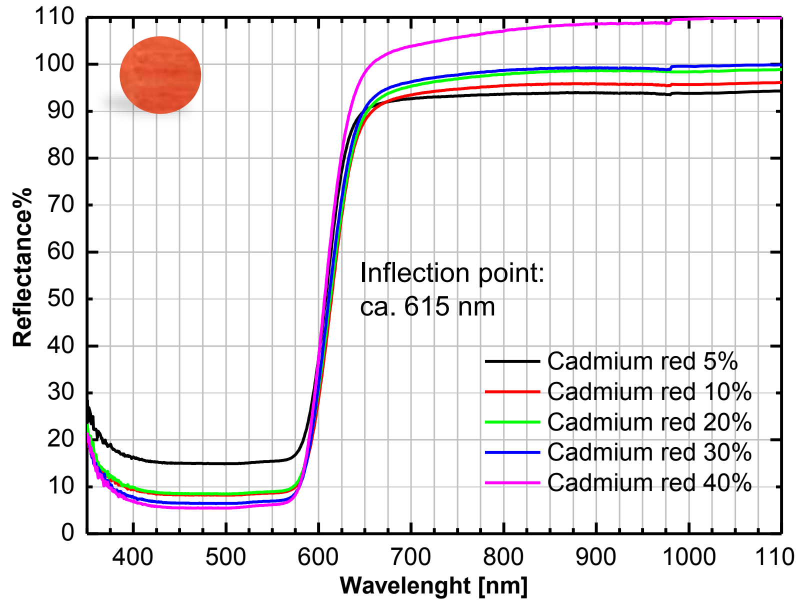


Figure 6.26. FORS spectra of cadmium red watercolour paint (geometry of analysis: 8º/8º).

Cadmium red [Cd(Se,S)] is a semiconductor and for this reason, the reflectance spectra obtained show a S-shape behaviour presenting a broad absorbance band centred at ca. 470 nm and an inflection point at ca. 615 nm due to a band-to-band transition in cadmium [*see* ***Appendix A6.6***] (***Figure 6.26***). According to the selenium:sulphur ratio and the preparation method of the pigment, different colours can be obtained [Fielder and Bayard 1986, 70; Boselli 2010, 145]. In some cases, due to this fact, cadmium red may present an inflection point at ca. 600 nm as in the case of vermilion (as it will be further seen) making difficult the distinction between both pigments with UV-Vis diffuse reflectance methodologies. As in the case of cadmium yellow, the high values of reflectance are related with the glowing hue of the pigment, which decreases with the dilution of the watercolour paint. Moreover and for this reason, in the case of the mock-up 40% the extremely high reflectance value (highly saturated colour) can be attributed to the strong influence of specular reflectance[303].

Aiming to obtain orange intermediate colours between cadmium yellow and cadmium red, two different solid mixtures were prepared in laboratory, as previously indicated in ***Table 6.1***. In this study, these mixtures were named "cadmium orange deep" for the reddish mixture and "cadmium orange light" for the yellowish one. Thus, these denominations are not related with commercial names of the cadmium orange pigment. Cadmium orange deep was prepared from a solid mixture 80% cadmium yellow (CdS) and 20% cadmium red [Cd(S,Se)]. Cadmium orange light: solid mixture 50% cadmium yellow and 50% Cadmium red.

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[303]The influence of specular reflectance is observed in the spectra obtained with FORS (8º/8º and 0º/2x45º probe geometries). The technique did not avoid the influence of this phenomenon in the analysis of cadmium yellow and cadmium red pigments [Cf.http://mowcres.ifac.cnr.it.].

The reflectance spectra obtained for both mixtures are very similar showing a combination of both cadmium yellow and cadmium red pigments, showing two inflection points (***Figure 6.27 and 6.28***). The first at ca. 506 nm due to cadmium yellow and the second at ca. 600 nm related with cadmium red, as previously discussed. The combination of both colours in the watercolour paints in study show an increase of the reflectance values with the dilution of the colours.

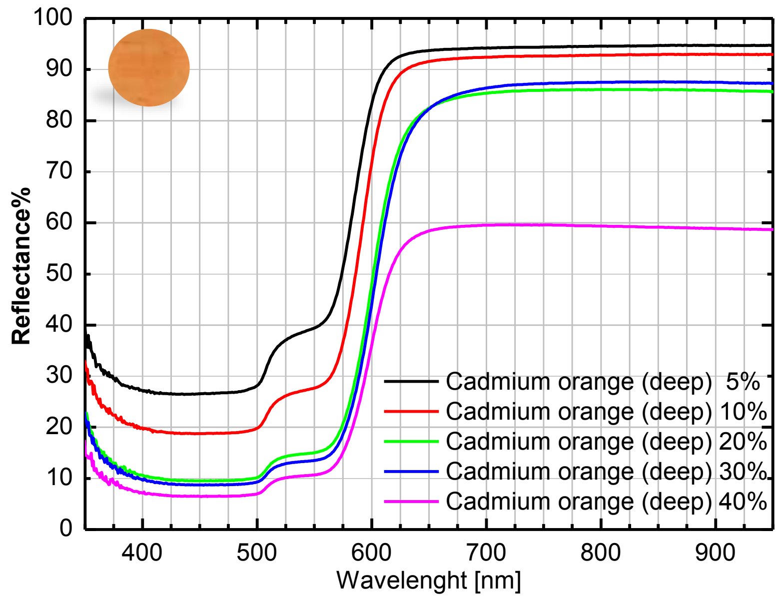

Figure 6.27. FORS spectra of cadmium orange (deep) watercolour paint (geometry of analysis: 8º/8º).

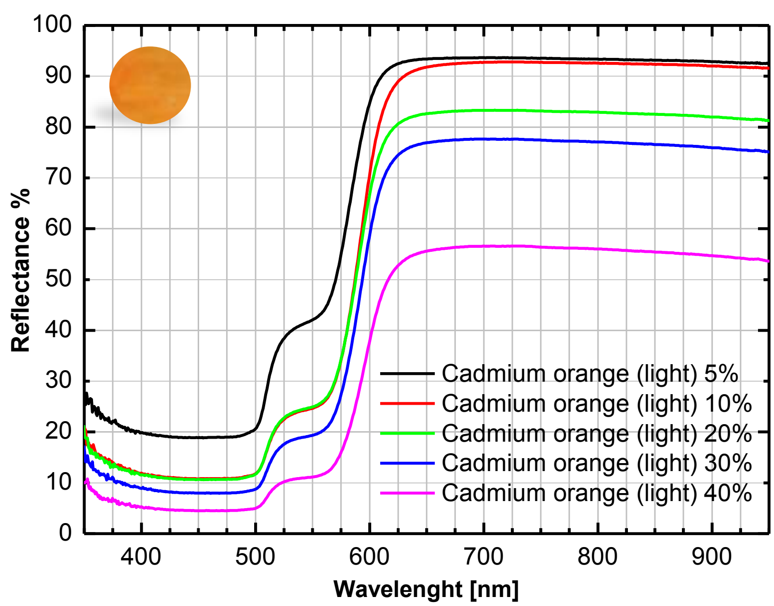

Figure 6.28. FORS spectra of cadmium orange (light) watercolour paint (geometry of analysis: 8º/8º).

- ***Red colours***

Vermilion (HgS) is the synthetic variety of the pigment obtained from the mineral cinnabar [Miguel 2012, 28]. As mentioned by Church, cinnabar occurs in many parts of Europe, abundantly in China and in New Almaden in California. Moreover, the name vermilion derived from the Latin *vermes* which name was originally designate the *kermes* insect used for the preparation of a red dye [Church 1915, 186].

During the 19th century, many variants of this pigment were produced [Eastaugh *et al.* 2008, 387]. According to a source from W&N, vermilion in watercolour can be defined as in the following citation: *[…] and opaque bright scarlet red, higher in its tone than any of the other but a want of transparency, and its not flowing well, preclude its being used so generally as would be desirable: it stands well* [*The Handbook* W&N n.d., 22].

In the catalogue of W&N ca. 1896, vermilion is included among the moderately permanent colours [Catalogue W&N 1896, xxxix].

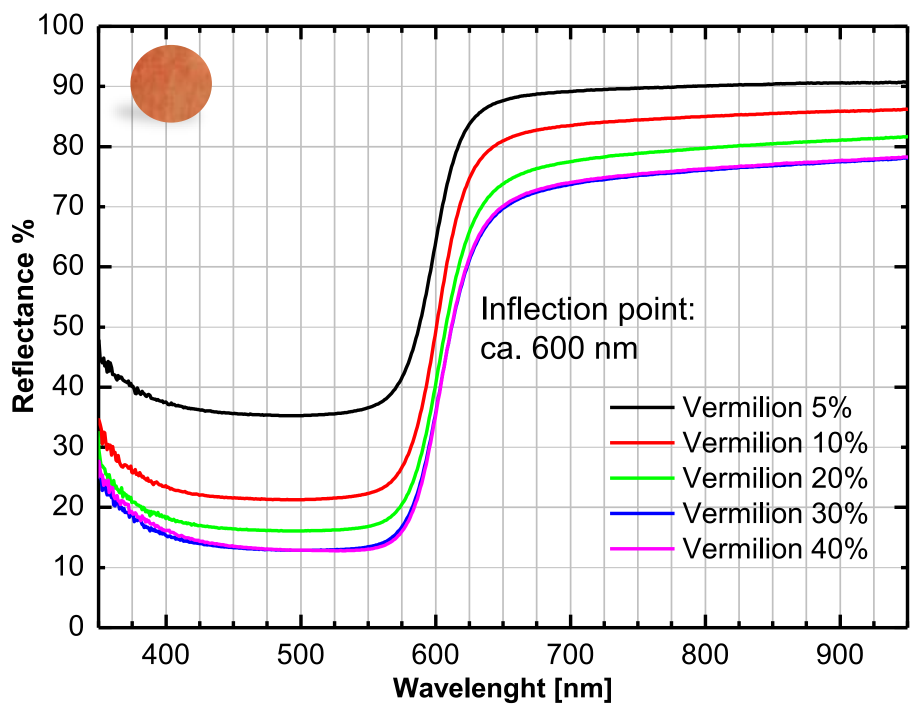

Figure 6.29. FORS spectra of vermilion watercolour paint (geometry of analysis: 8º/8º).

The reflectance spectra obtained for vermilion show an S-type band due to a band-to--band transition, with an inflection point located at ca. 600 nm (***Figure 6.29***) [*see* ***Appendix A6.6***] [Bacci 2000, 334; Boselli 2010, 163].

- ***Bordeaux colours***

Carmine is the term applied to designate the cochineal lake [Eastaugh *et al.* 2008, 85]. Cochineal consists of dried insects from the species of *Porphyrophora* and *Dactycopius* [Eastaugh *et al.* 2008, 86]. In the early 20th century, carmine lake was produced by precipitating cochineal extract with solutions of potassium carbonate and alum [Church 1915, 207].

W&N catalogues used to present this lake under several names[304]. In the catalogue of W&N ca. 1896, carmine lake is listed among the watercolours as a fugitive colour [Catalogue W&N 1896, xxxix]. In fact, as previously referred in ***Chapter 4***, carmine lake shows tendency to fade.

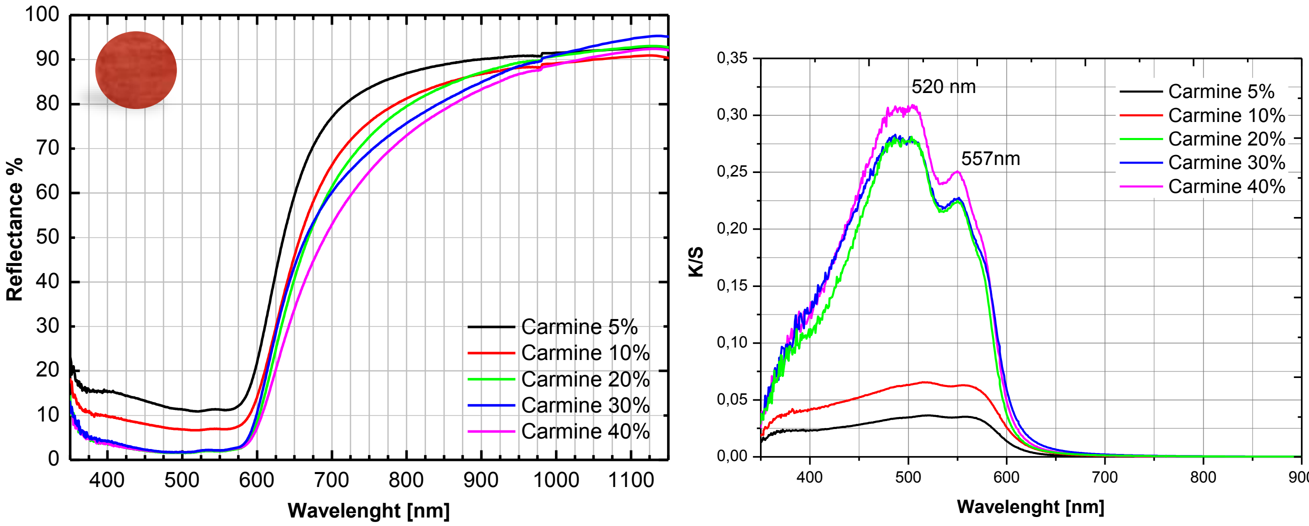

Figure 6.30. *On the left:* FORS spectra of carmine watercolour paint (geometry of analysis: 8º/8º).
On the right: Respective Kubelka-Munk function spectra.

The interpretation of the reflectance spectra obtained for carmine (***Figure 6.30***) follows the paradigm of the studies presented by Bisulca *et al*. (2008) and Vitorino *et al.* (2015). The spectra behaviour shown may be assigned to the n→π* transitions that occur in the carbonyl group of antraquinone based dyes (***Figure 6.31***). Carmine presents two absorption bands located at ca. 520 nm and 557 nm [Bisulca *et al.* 2008; Vitorino *et al.* 2015]. The inflection point is located at ca. 620-625 nm [*see* ***Appendix A6.6***].

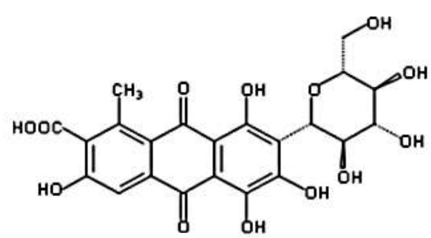

Figure 6.31. Carminic acid, the main chromophore of carmine [Bruni *et al.* 2011].

[304]Some synonyms of this lake used in England: cochineal lake, crimson lake, crimson lake extra, extra carmine lake, crimson lake extra fine. When combined with vermilion carmine assumed names as carmine vermilion and Florentine and Chinese lake [Carlyle 2001, 507].

Alizarin (***Figure 6.32***) is the chromophore of madder root (*rubia tinctorum* specie) which was chemically isolated in 1826 [Carlyle 2001, 508; Eastaugh *et al.* 2008, 10]. Madder lakes are characterised by the presence of anthraquinones. Among the most important of these molecules present in madder are alizarin, purpurin and pseudopurpurin [Eastaugh *et al.* 2008, 250]. According to their intensity, madder colours may assume different names. In descending order of colour intensity: Madder Carmine, Madder Lake, Rose Madder and Pink Madder [Carlyle 2001, 508].

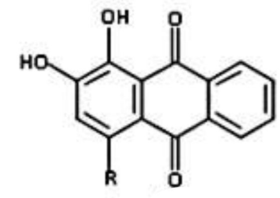

Figure 6.32. Alizarin if R=H, the main chromophore of madder [Bruni *et al.* 2011].

In the catalogue of W&N ca. 1896, Pink Madder is listed among the watercolours as a permanent colour [Catalogue W&N 1896, xxxviii]. This variety of madder has a little less depth than Rose Madder [*The Handbook* W&N n.d., 23]. In this same catalogue is listed *Rose Dorée* which was considered a variety of Rose Madder inclining to Scarlet [Carlyle 2001, 510].

Church refers that madder colours are less affected to light than carmine lakes and lists the different changes of hue to the several madder pigments in watercolour according to the exposition time to light [Church 1915, 198].

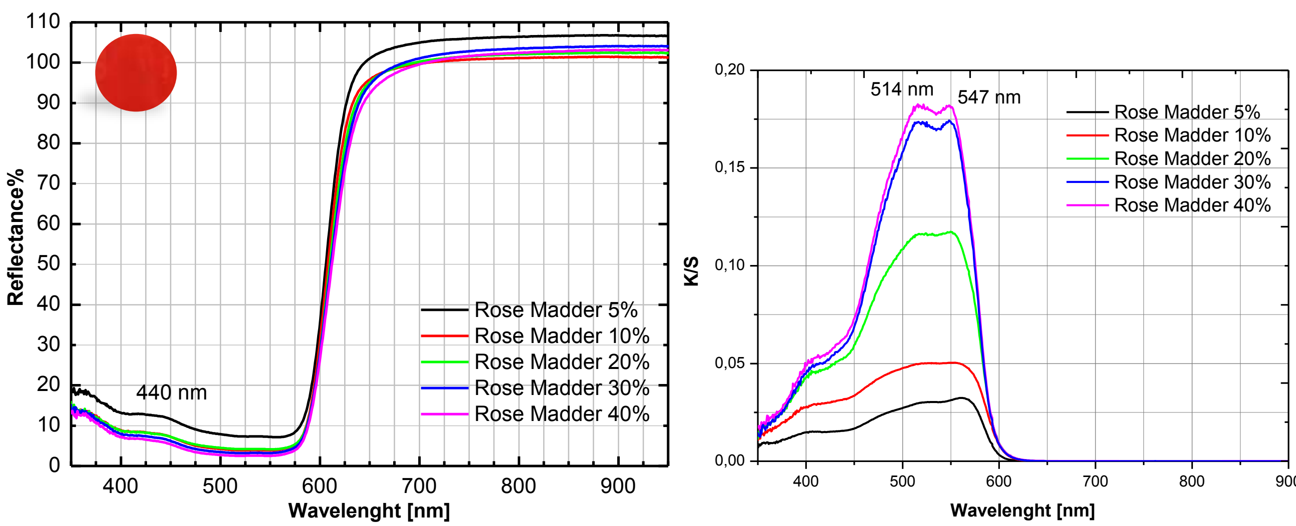

Figure 6.33. *On the left:* FORS spectra of rose madder watercolour paint (geometry of analysis: 8º/8º). *On the right:* Respective Kubelka-Munk function spectra.

The reflectance spectra of rose madder (***Figure 6.33***) show a reflectance maximum at ca. 440 nm. Two absorption sub-bands are observable at ca. 514 nm and 547 nm. This spectral behaviour in the Vis region can be assign to the n→π* transitions of the carbonyl group, characteristic of antraquinone based dyes [Bisulca *et al.* 2008; Vitorino *et al.* 2015; Aceto *et al.* 2014]. The spectra present an inflection point at ca. 606 nm [*see* ***Appendix A6.6***].

Note that the reflectance spectrum concerning the mock-up 5% show reflectance values up to 100%, probably as consequence of the texture of the sample that had increased the amount of back--scattered radiation from the surface of the mock-up to the spectroanalyser.

- ***White colours***

Zinc white (ZnO) in the form of a fine white powder is known since antiquity. However, only in the late 18th century this pigment started being used in painting [Kühn 1986, 170]. Around 1834, W&N began producing a peculiarly dense form of this pigment under the name *Chinese white* [Church 1915, 153; Carlyle 2001, 516]. Among the set of pigments for watercolour painting, the catalogue from W&N from c. 1896 lists this pigment as permanent colour [Catalogue W&N 1896, xxxviii]. According to a source from W&N, in what concerns *Chinese white* in watercolour it is referred the quality of this pigment: *[...] The eligibility of this material for certain purposes in watercolour painting having opened within these few years a new era in that art, it may not be considered irrelevant briefly to review the causes that have operated to its general adoption* [*The Handbook* W&N n.d., 32]. *[...] This combination of qualities, body and permanency became thus a desideratum* [*The Handbook* W&N n.d., 33]. Church referred that *for watercolour painting, zinc white is practically perfect* [Church 1915, 153].

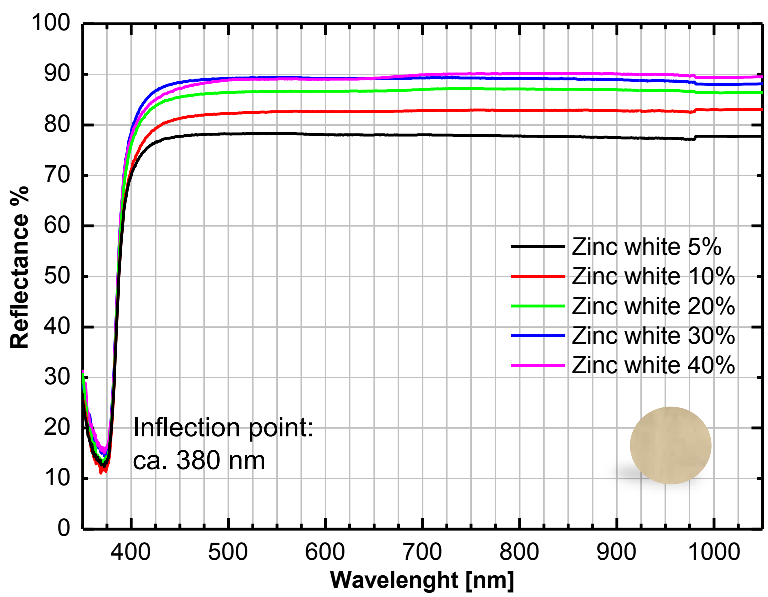

Figure 6.34. FORS spectra of zinc white watercolour paint (geometry of analysis: 8º/8º).

Zinc oxide is a semiconductor and the reflectance spectra of this pigment show an S-type absorption band shape with a characteristic inflection point at ca. 380 nm (***Figure 6.34***) [*see* ***Appendix A6.6***] [Picollo *et al.* 2007]. With the decrease of the dilution, the spectra show an increase of the reflectance factor probably related with the glowing surface due to the increase of the concentration of pigment. This reflectance behaviour was also observed in the other white colours in study as it will be further observed.

Barium sulphate ($BaSO_4$) natural form is barite which was used as an adulterant of lead white around 1782 due to health hazards [Church 1915, 154; Picollo *et al.* 2007; Eastaugh *et al.* 2008, 46]. Some of the names of this pigment were Baryta-white, Permanent White and Constant White [Church 1915, 154; Carlyle 2001, 516]. In the 19th century, Barium sulphate was used alone only as watercolour pigment because of its lacked body and opacity and was considered among the best whites for watercolour [Carlyle 2001, 516].

A source from W&N also refers some of the characteristics of this pigment in watercolour: *A very high toned white […] it has very little body, on which account it is hardly visible when first laid on, but dries exceeding high and bright* [*The Handbook* W&N n.d., 35]. In catalogue from W&N from c. 1896 this pigment is presented as permanent colour [Catalogue W&N 1896, xxxviii].

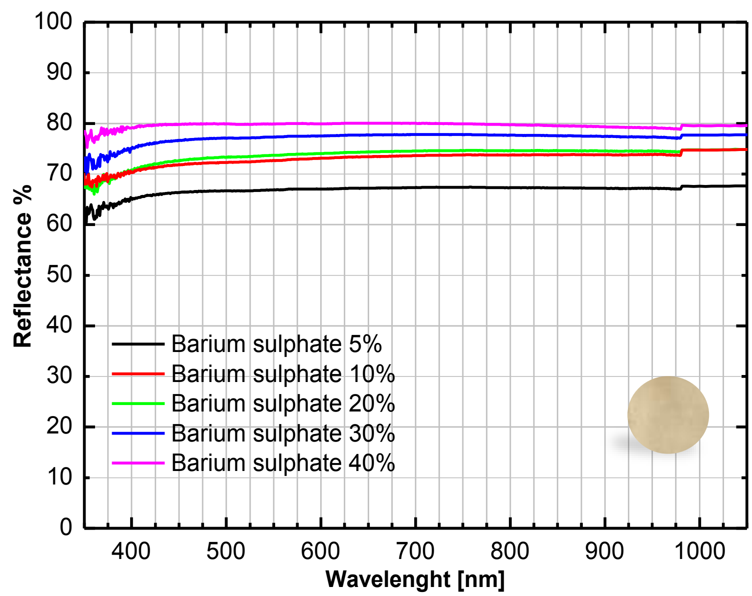

Figure 6.35. FORS spectra of barium sulphate watercolour paint (geometry of analysis: 8º/8º).

The reflectance spectra of barium sulphate (***Figure 6.35***) do not show any particular feature in the Vis region that allows the identification of this pigment. As observable, the reflectance spectra show a high overall reflectance characteristic of white pigments [Picollo *et al.* 2007].

Church mentioned the several mixtures of barium sulphate and zinc sulphate that were introduced at the time [Church 1915, 155]. The discovery of lithopone ($ZnS+BaSO_4$) is attributed to Doubet and probably occurred around 1850 and it started being produced in large scale in 1874 [Eastaugh *et al.* 2008, 248].

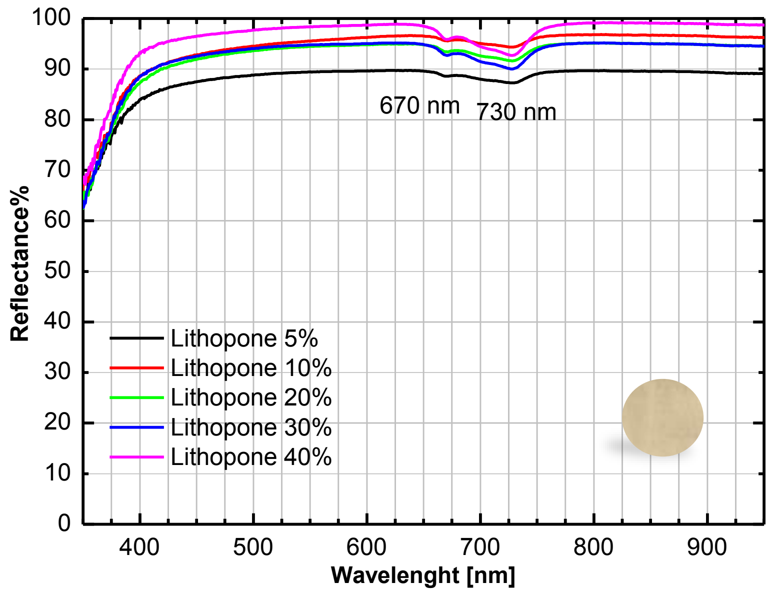

Figure 6.36. FORS spectra of lithopone watercolour paint (geometry of analysis: 8º/8º).

According to literature, lithopone reflectance spectrum shows an S-type band shape due to the presence of ZnS in the pigment composition. It is reported that lithopone presents an inflection point at ca. 340 nm which is not visible in ***Figure 6.36***, since measurements were carried out from 350 nm. The reflectance spectra obtained also show a weak composite absorption band between 650 and 750 nm as would be expected for a cobalt (II) ion in a pseudo-tetrahedral sulfur coordination in ZnS. Moreover, this is a characteristic feature of lithopone pigments produced after the mid-1920s[305] [Picollo *et al.* 2007].

Lead white [$2PbCO_3 \cdot Pb(OH)_2$] is also a pigment known since antiquity [Eastaugh *et al.* 2008, 239].

According to a source from W&N concerning the application of Flake white ($PbCO_3$) in watercolour, it is reported: *a preparation of carbonate of lead and consequently unfit for watercolour painting, being liable to turn to a dark brown* [*The Handbook* W&N n.a., 34].

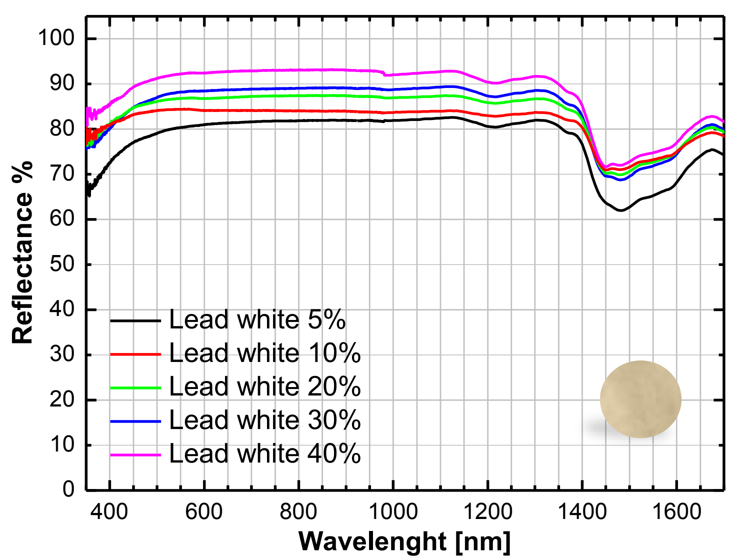

Figure 6.37. FORS spectra of lead white watercolour paint (geometry of analysis: 8º/8º).

[305]As mentioned in the beginning of this chapter, the pigments used are commercially available.

Lead white reflectance spectra (***Figure 6.37***) do not show any particular feature related with the pigment. The characteristic absorption peak located around 1450 nm concerning a hydroxyl group first overtone of the stretching mode vibration is masked by the signal of paper [Picollo *et al.* 2007].

- ***Black colours***

Graphite, vine black and ivory black are all carbon-based pigments [Eastaugh *et al.* 2008]. In particular, a source from W&N reports Ivory black [$C + Ca_3(PO_4)_2$] use as pigment for watercolour painting: *Is the richest and most transparent and has a slight tendency to brown in its pale washes* W&N [*The Handbook* W&N n.d., 31]. The catalogue from W&N from c. 1896 lists ivory black pigment as a permanent colour [Catalogue W&N 1896, xxxviii]. Church refers graphite as a deep pigment adapted for the use in watercolour [Church 1915, 217]. Vine black, as known as charcoal black, is also mentioned by the same author: *Charcoal withdraws the majority of organic colouring matters from suspension, and even from solution in water* [Church 1915, 269].

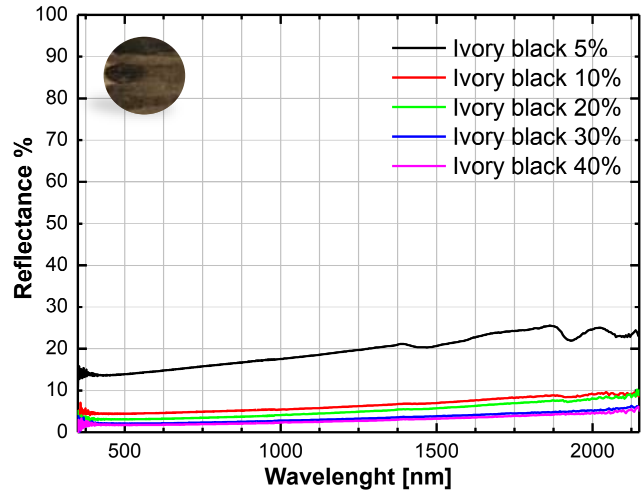

Figure 6.38. FORS spectra of ivory black watercolour paint (geometry of analysis: 8º/8º).

Ivory black reflectance spectra (***Figure 6.38***) do not allow the observation of any characteristic feature of this pigment due to the very low reflectance values [Boselli 2010, 154]. Analogous results were observed for graphite and vine black (***Figure 6.39***).

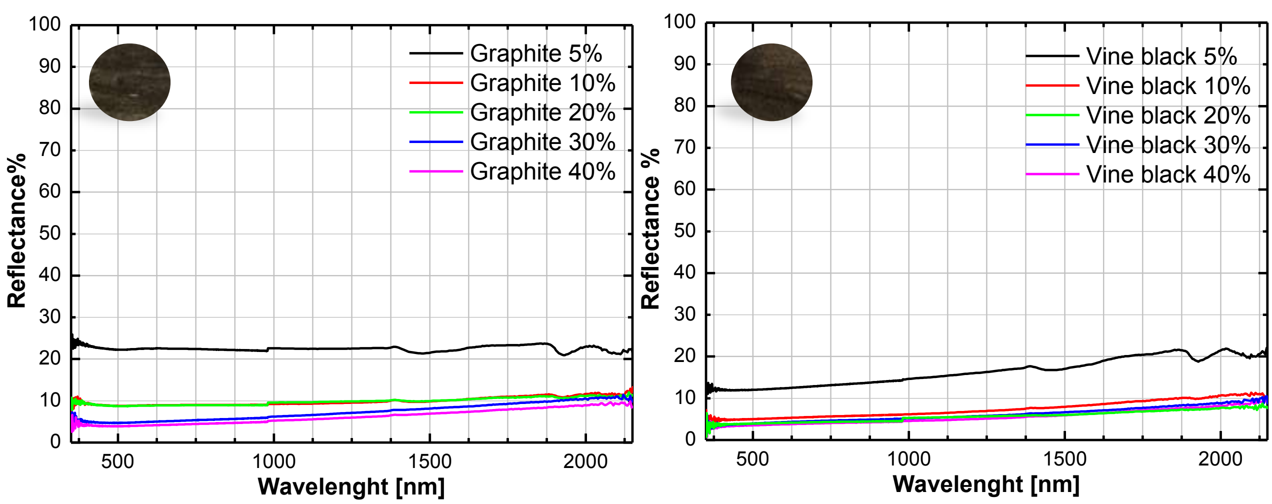

Figure 6.39. *On the left:* FORS spectra of graphite watercolour paint (geometry of analysis: 8º/8º). *On the right:* FORS spectra of vine black watercolour paint (geometry of analysis: 8º/8º).

Table 6.2. *Résumé* of the pigments analysed for the spectral database.

Category	Pigment	Band position and characteristics
Violet	Cobalt violet (arsenate)	ca. 530 and 580 nm[a]
	Cobalt violet (phosphate)	ca. 533 and 587 nm[a]
Blue	Cerulean blue	ca. 560, 600, 656, 1520, 1640, 1805 nm[a]
	Cobalt blue	ca. 544, 585, 631 nm[a] and 3 sub-bands between 1200-1500 nm
	Indigo	ca. 660nm[a]
	Prussian blue	Between ca. 600 and 1000 nm[a]
	Ultramarine blue	600 nm[a]
Green	Chrome oxide green	ca. 463 and 600 nm[a]
	Viridian	ca. 437 and 632 nm[a]
	Cobalt green	ca. 561, 607, 657, 1306, 1440 and 1655 nm[a]
	Schweinfurt green	Between 650 and 1000 nm and ca. 1685 nm[a]
Yellow/ Brown	Yellow ochre	ca. 490 nm, 660 nm and 950 nm[a] (1390 and 1418 nm (Kaolinite))
	Raw sienna	ca. 490 nm, 660 nm and 950 nm[a]
	Burnt sienna	ca. 850 nm[b]
	Chrome yellow	ca. 460nm[a]; 550nm[b]
	Naples yellow	ca. 510 nm[b]
	Cadmium yellow	ca. 520 nm[b]
Orange	Cadmium orange (mixture Cadmium yellow and Cadmium red)	ca. 500 nm and 615 nm[b]
Red	Cadmium red	ca. 615 nm[b]
	Vermilion	ca. 600 nm[b]
Lakes	Carmine	ca. 520 and 557 nm[a]; ca. 620-625 nm[b]
	Rose Madder	ca. 514 and 547 nm[a]; ca. 606 nm[b]
White	Zinc White	ca. 380 nm[b]
	Barium sulphate	--[c]
	Lithopone	ca. 670 and 730 nm[a]
	Lead white	--[c]
Black	Ivory black	--[c]
	Graphite	--[c]
	Vine black	--[c]

[a]Absorbance maximum; [b]Inflection point; [c] No clear spectral features detectable.

6.4. Conclusion

This study presents a modern watercolour reflectance database created from commercially available pigments. This database is *online* for the use of conservation scientists and other researchers.

The results obtained through the three methodologies followed (FORS geometries 8º/8º and 0º/2x45º and laboratory DRS) confirmed the accuracy of FORS data in comparison with the results achieved by a laboratory spectrophotometer. However, in some particular cases (cadmium-based pigments and rose madder), the used FORS measurement geometries showed limitations in avoiding the influence of specular reflectance or due to the texture of the sample in analysis.

In general, even if the methodologies followed made available the range between 780-2200 nm (and 2500 nm in the case of DRS) in most cases, the spectral features of the paper as support in this range could have masked the characteristic absorption features of pigments and lakes in study. Some exception occurred in the characterisation of cerulean blue, cobalt blue and cobalt green. However, only when the watercolour paint was more concentrated some characteristic absorption bands of the pigments in analysis were observed (Schweinfurt green and kaolin present in yellow ochre).

In the spectral range between 350-950 nm it was possible to identify the characteristic features of almost all pigments in study. Exception was given for some white and black colours. Moreover, reflectance spectroscopy in this range does not allow an unequivocal characterisation of some pigments which present similar spectral behaviour like vermilion and cadmium red, chrome yellow and cadmium yellow, yellow ochre and raw sienna and between cobalt violet arsenate and cobalt violet phosphate. For all pigments with exception to cadmium yellow, cadmium red and white colours, it was observable a decrease of the reflectance factor with the increase of the concentration of pigment, i.e. the paint mock-up more diluted showed greatest reflectance factor. No shift in the reflectance peaks values was observed due to paint dilution.

FORS methodology can be considered a useful technique for preliminary analyses of watercolour paint layers in unmixed form. Results should be complemented when possible with other techniques as μ-Energy-Dispersive X-Ray Fluorescence Spectroscopy and Raman microscopy.

The modern watercolour reflectance database built in this study reveals the importance of a suitable database for the characterisation of pigments in artistic works like Amadeo de Souza--Cardoso's *La Légende de Saint Julien l'Hospitalier*.

Every saint has a past and every sinner has a future.

Oscar Wilde from *A Woman of No Importance*, 1893.

CHAPTER 7: Concluding remarks and future research

Following an interdisciplinary approach, the study presented in this dissertation, concerning the history, materials and techniques of *La Légende de Saint Julien l'Hospitalier* (1912), provided, for the first time, a holistic view of this emblematic and culminating artwork from Amadeo de Souza-Cardoso's early career (1907-1912). The investigation presented here also reflects the importance of joining synergies between different disciplines, such as Art History and Conservation Science in order to a deep understanding of the secrets hidden in an artwork: the historical context of its creation, the *modus operandi* followed by the artist and the original materials and techniques employed – which were also crucial for choosing the best strategies for conservation.

Amadeo de Souza-Cardoso's early career was strongly influenced by the artistic transformations occurring in Paris at the time. As an active member of the so-called *École de Paris*, Souza-Cardoso was immersed in an artistic milieu characterised by the exchange of creative ideas between French and foreign artists. Amadeo was overwhelmed by the artistic novelty offered by the French capital at the time and since the first day of his stay in the city he was in *a state of permanent attention and creation*[306]. For this reason, Amadeo was certainly aware of the production *livres d'artiste*, since they were a mean of self-assertion for several artists connected to the *avant-garde* movements of the early 20th century. Amadeo knew well Guillaume Apollinaire and André Derain, Max Jacob and Pablo Picasso, some of the protagonists of the first Parisian artists' books.

Amadeo followed the idea of creating a book, at least since 1908, when he shared his ideas with his friend and confident Manuel Laranjeira. However, this joint project never came through, since Laranjeira passed away in February 1912. In that same year, during the summer holidays spent in Brittany, Amadeo accomplished the project through the creation of the manuscript *La Légende de Saint Julien l'Hospitalier*. This study suggests that this artwork can be considered as a sort of homage from Souza-Cardoso to his late friend, who defended the thesis in Medicine *A doença da santidade. Interpretação psicológica do misticismo* [A Psychological Interpretation of Mysticism – The Disease of Sanctity] and who encouraged him during his first steps as an artist. In fact, Flaubert was one of the

[306] Cf. Freitas 2008, 19.

authors discussed in the gatherings at the *Café Chinez* led by Manuel Laranjeira, where Amadeo participated during his stays in Espinho. The dramatic story of Saint Julian the Hospitaller also seems to find some meeting points with Laranjeira's tragic end. Moreover, the book *Commigo – versos de um solitário* also with the authorship of Laranjeira (dated c. 1912) – that Souza-Cardoso owned in his personal library, was bound with the same material [parchment] as *La Légende* having also drawn in the cover the emblem from the *XX Dessins*.

From this study becomes also clear that Amadeo de Souza-Cardoso was determined to follow an original way in his work. The construction and structure of his manuscript may be comparable to a house with many divisions. The doors of that house are the many blank/white pages present in the book and the divisions correspond to each illustrate page. The dialogue between text and image and the way how the entire volume was organised also contributes to the aesthetic richness and meaning of this artist's book. Contrarily to the Parisian *livres d'artiste* and Russian *avant-garde* books, the manuscript *La Légende de Saint Julien l'Hospitalier* remained a single piece and a unique copy. According to the investigation carried out, other handwritten artists' books occurred only after the decade of 1920s and were always followed by a process of mechanical printing with the intention of producing several copies. This fact highlights the innovative character of Amadeo's work. In addition, the artist created this manuscript from his own initiative and opted to illustrate a tale from a writer from the previous century. These were uncommon procedures in that period. This study also allowed concluding that among the Portuguese production of artists' books, *La Légende* can be placed as pioneer in the context of the Portuguese Modernism. Other artists' books began occurring circa a decade later.

Brittany was considered an inspiring destination for many artists at the time and it was also to Amadeo. In *La Légende* is clear the importance of travelling for him. Citing the artist: *Journeys are then, the great book of the artist. They are vital to him as the Bible and Latin are to the priest… In every book, one must turn the page, and turning the page is [here] the equivalent of a journey*[307]. The Portuguese artist visited Concarneau, the city where Flaubert started writing the tale about Saint Julian and probably those panoramas inspired Amadeo to illustrate it. Many decorative elements found in his manuscript are related with this trip. Using the artist's words, this work marks the turn of a new page in his career, where he finally found his artistic style: being *a bit of everything*[308]. Crossing the borders between Modernism and Medievalism, the artist's geniality is also mirrored in the harmonious way how he graphically combined the many influences that inspired him in the conception of this modernist codex. The analysis carried out also revealed the *avant-garde* artists and artistic movements that inspired Amadeo. The multiple decorative elements inspired in medieval illuminated manuscripts (namely, Flemish Books of Hours), show as well an uncommon interest for ancient art for a modernist artist. The influence of popular and religious elements such as *ex-votos* and Russian iconography, that Amadeo also appreciate, was found in *La Légende*. The latter establishes a common similarity in the drawing between

[307]In a letter to his mother (Paris, June 1907), Amadeo referred the importance of travelling for his work [apud Freitas 2006, 24].
[308]*See General Introduction* of this dissertation.

Amadeo's manuscript and the Russian *avant-garde* books. Nevertheless, this study also points out that the first of those books was published, for the first time, in October 1912, while the Portuguese artist started his artist's book some months before, during the months of July and August of that same year. So the hypothesis of Amadeo being inspired by such books does not seem plausible.

The bookbinding of *La Légende* is album-type and the state of conservation of the manuscript can be considered stable. Its cover material is parchment (or vellum), which clearly establishes a relationship with Middle Ages. The use of this material was considered rare at the time. This study confirms that Amadeo was also attentive to the materials he used in his works, selecting materials of good quality. The paper of the text block is *Whatman* paper, considered the perfect material for the practice of watercolour technique. The quality of the materials employed is similar to that found in the Parisian *livres d'artiste*.

In what regards the conservation state of the manuscript, the degradation of paper from the fly-leaves and guards and the oxidation of the silver painted areas are the most important conservation issues found in Amadeo's artist's book.

The analysis of Amadeo's artistic technique applied in the conception of *La Légende* allows the reader to imagine the artist *in the making*. This study suggests the influence of the publication *Drawings from the Old Masters* on Japanese watercolour drawings that Amadeo bought in 1907. Moreover, it also confirms Manuel Bentes words [*see* ***Chapter 1, section 1.3***] referring that watercolours and drawings never had secrets to Amadeo. In fact, the drawing lines and the brushstrokes are precise and the tight contours do not show any sign of hesitation. This aspect is notorious in the artist's rigor in the copy of the full Flaubert's text as well. This study also revealed that Amadeo *modus operandi* was eclectic: in some pages of the manuscript, Amadeo opted to copy the text first and illustrate the page after; in others, the artist opted to reverse the procedure. This working method seems related with the artist's idea that temperament was more important than technique in the creation of an artwork.

In the present research, *in situ* analytical techniques were applied in the identification of the pictorial materials used by Amadeo de Souza-Cardoso in his manuscript. However, the main focus of this project was the study of the advantages and drawbacks of FORS technique in the analysis of this graphic document. One of the most important incomes of FORS methodology in the analysis of this case study regards the portability of the device, which made easy its use in the museum habitat. In fact, carrying an artwork from the museum to the laboratory is not always possible or viable, being in addition costly. Furthermore, the creation of a suitable UV-Vis-NIR spectral database allowed an adequate identification of the pigments and lakes by comparison of the spectral behaviour, location of absorption bands and inflection points. In the areas analysed, Amadeo applied, in general, pure colours without mixtures. FORS analyses allowed the identification of almost all pigments/dyes and lakes. Exception was given to red inorganic pigments, as already expected (e.g. vermilion and cadmium red), which present the same spectral features. Also black pigments were not accurately identified with this technique: the results obtained show a strong absorption band covering the entire spectral range of analysis. The application of other *in situ* techniques such as Raman spectroscopy and μ-EDXRF provided the entire picture of the pictorial palette used by Amadeo de Souza-Cardoso. Nevertheless, any of the techniques employed was efficient in the identification of the binding medium present in Amadeo's colours. Although the chemometrics approach followed in this case suggested, tentatively, the presence of Arabic gum, it shall be more adequate the application of an analytical technique that could make possible a direct identification of this material.

The pictorial palette has been successfully identified and is in accordance with previous studies concerning the artist's pictorial palette between 1913 and 1916 [Vilarigues *et al.* 2008; Vilarigues *et al.* 2009] and in last paintings from c. 1917 [Montagner 2015], with the exception of chrome yellow and cerulean blue. Amadeo's pallete in *La Légende* is mostly composed by coloured and stable pigments, excluding carmine and the scarlet ink eosin Y. The slight differences between the three palettes seem to be related with the characteristic experimentalism of the artist.

In this dissertation, it was applied simply the term "in situ", to indicate characterisation analysis not involving the need of micro sampling to be studied in laboratory. The analytical techniques employed in this study are commonly indicated as "non-invasive" or "non-destructive". However, as pointed out by researcher Catarina Miguel for the study of medieval manuscripts, it would be very important to monitor the areas analysed with these techniques over periods of 10, 20 or 50 years in order to exam if any damage occurred due to these analyses [Miguel 2012, 130].

Colour plays in *La Légende de Saint Julien l'Hospitalier* a particular role, probably due to the influence of Robert Delaunay's discoveries in Amadeo de Souza-Cardoso's artistic production. The colour mapping investigation revealed to be a powerful tool for the study of the distribution of colours along with the illustration of the tale; they were not done by chance. In fact, Souza-Cardoso employed colour to give vigour to Flaubert's words and this resource, consciously or unconsciously, creates dynamism, causing emotions in the reader. A relationship between the colours applied by Amadeo and Kandinsky's essay on *Concerning the Spiritual in Art* (1911) was also established in an essay.

From this study, the preventive conservation guidelines established were made available to the museum were *La Légende de Saint Julien l'Hospitalier* is kept in custody in order to preserve this artist's book in the most appropriate conditions.

Finally, the results from this investigation and the singularity of this manuscript among the Portuguese and international universe of artists' books production, may contribute to *Fundação Calouste Gulbenkian*'s effort on promoting the recognition of this surprising artist who knew having a *destiny to fulfil*[309]. In fact, until now, *La Légende* was never presented in an exhibition as an artist's book. This thesis contributes to the critical reception of this peculiar piece and to its dissemination.

[309]From a letter from Amadeo to his mother (Pont-l'Abbé October 3, 1907) [apud Freitas 2006, 22].

❍ Future work

The investigation presented in this dissertation is the first study concerning the history, materials and techniques of Amadeo de Souza-Cardoso in his early career (1907-1912). For this reason, more research should be carried out on this subject. The manuscript *La Légende de Saint Julien l'Hospitalier* (1912) was selected as case study for the investigation of the referred period, since is considered an emblematic work and marks the terminus of Amadeo's period most dedicated to drawing. For a complete picture of the materials and techniques employed by the artist during those years, it is recommended the analysis of other paintings and drawings aiming the validation of the results presented in this dissertation. It is also suggested the analysis of the materials and techniques of watercolour works from the last period of Souza-Cardoso's career for comparison.

It would be also pertinent to establish a parallelism between Amadeo's materials and those used by other artists from his circle of Parisian friendships and acquaintances, namely, Robert and Sonia Delaunay. In what concern the latter, it would be interesting to study if Souza-Cardoso's works, particularly *La Légende*, inspired her in the production of her artist's book (in collaboration with Blaise Cendrars) in watercolour in January of the following year.

The artist's irregular formation at the Parisian *académies libres* should also be considered in future studies. Here is highlighted the materiality of Anglada Camarasa's oeuvre – as Amadeo's painting master[310], which may have influenced the Portuguese artist's materials choices in particular in his early career.

From the art historical perspective, it would be of particular relevance the investigation of other Amadeo's estates (e.g. Souza-Cardoso's family in Manhufe). It may provide new inputs concerning the context of the creation of the artist's book *La Légende*. Furthermore, this study could also provide new insight from the analysis of studio materials and/or sketches or other relevant documents and materials that may exist (e.g. the book Amadeo used to copy Flaubert's *La Légende*).

Amadeo de Souza-Cardoso's manuscript presents some resemblances with works by William Black and William Morris, who are considered the precursors of the artists' books. No evidence was found that allows confirming such influences in Souza-Cardoso's work. Nevertheless, it would also be interesting to investigate if some relationship can be established. The influence of German Expressionism in Amadeo's manuscript and the common interest with Otto Freundlich in Romanticism and folk art should also be taken into account.

[310]Cf. Fontbona de Vallescar, F. "Anglada Camarasa, o mestre de Souza Cardoso." Proceedings of the *1st International Conference Amadeo de Souza-Cardoso – Centenário da Exposição de Pintura (Abstraccionismo) Porto 1916*. Porto, Portugal (November 4-5, 2016) (in press).

As referred in the critical review of Maria Filomena Molder's essays, calligraphy was an important instrument for the Portuguese artist's metamorphosis. An investigation is also suggested to find a relation of Amadeo's writing exercise with the meaning of calligraphy in Japanese culture, since the artist was at least interested in Japanese drawings in watercolour, as already mentioned in this thesis.

Since the multi-analytical approach followed in the research presented in this dissertation did not allow the identification of the binding medium present in Amadeo's colours due to the influence of paper, it is suggested the analysis of the painted and handwritten areas through mid-IR-fibre optic reflectance spectroscopy. This molecular technique is considered adequate for the analysis of binding media and for materials characterisation on site. In what concerns the white areas painted on the cover of *La Légende de Saint Julien l'Hospitalier*, the characteristic features of the binding medium were also not identified through the FORS device used, since the limit range in the NIR region was 2200 nm. For the identification of the binding media in that case, the application of FORS analysis extended to the shortwave-infrared range (to 2500 nm) could make it possible.

Previous studies report alterations in eosin based lakes[311]. The eventual degradation (fading) of eosin Y ink in Amadeo's handwritten text should be considered in a future study.

In what concerns the oxidation of silver painted areas, it could be also interesting to test the application of a *task-specific ionic liquid gel*, to perform an electrochemical reduction of silver sulphide, following the paradigmatic study started by Joana São João at DCR-FCT-UNL [São João 2016]. Regarding the other silver oxidation compounds, in the case of silver chloride, the application of PMTA (1-phenyl-5-mercaptotetrazole) – a common corrosion inhibitor – [Zhu 1989, 166], could be tested in or order to act as a barrier for further corrosion.

Since calcium hydroxide [$Ca(OH)_2$] is one of the most used deacidification compounds in paper conservation due to the long-term physicochemical stability between calcium and cellulose [Kolar and Novak 1996], it would be interesting to test the application of a [$Ca(OH)_2$] nanoparticles suspension in isopropanol for the stabilisation of the fly-leaves and guards of *La Légende*.

Finally, concerning the modern watercolours reflectance database, since the reference spectra must be acquire from mock-ups used by artists as closely as possible, it is also recommended a preparation of mock-ups based on accurate historical reconstructions (pigments and binding media). Furthermore, it would be important to extend this approach to the study of the effect of photochemical ageing in the reflectance spectra features.

[311] Cf. Claro *et al.* 2010; Montagner 2015, 80.

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A1.1.* – Pages of Amadeo's *La Légende de Saint Julien l'Hospitalier

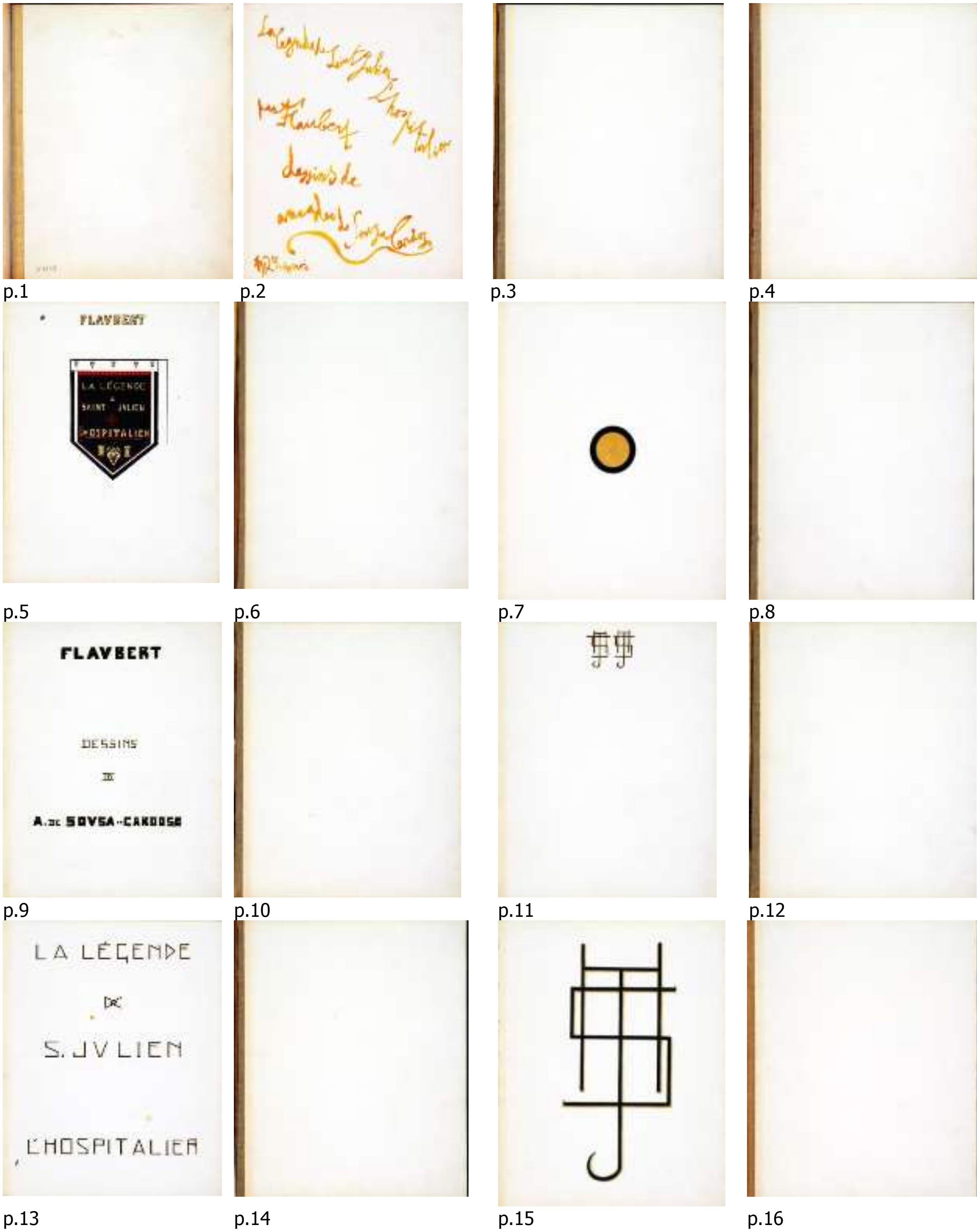


Figure I-1.1. From p.1 to 16 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

p.17 p.18 p.19 p.20

p.21 p.22 p.23 p.24

p.25 p.26 p.27 p.28

p.29 p.30 p.31 p.32

Figure I-1.2. From p.17 to 32 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

Figure I-1.3. From p.33 to 48 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

p.49 p.50 p.51 p.52

p.53 p.54 p.55 p.56

p.57 p.58 p.59 p.60

p.61 p.62 p.63 p.64

Figure I-1.4. From p.49 to 64 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

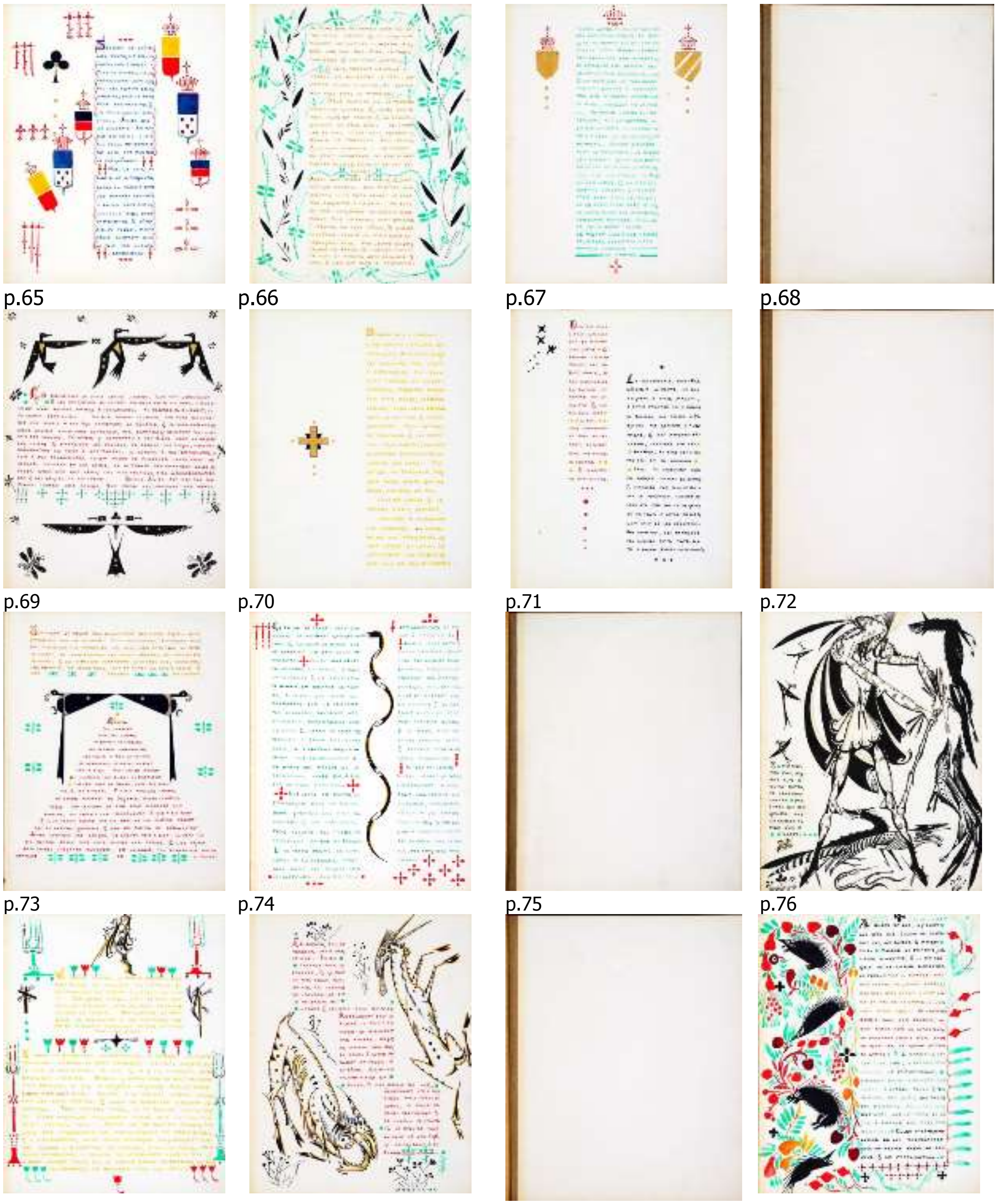


Figure I-1.5. From p.65 to 80 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.


p.81

p.82

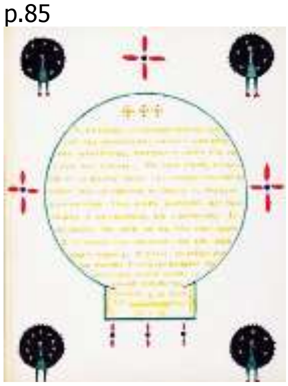
p.83

p.84

p.85

p.86

p.87

p.88

p.89

p.90

p.91

p.92

p.93

p.94

p.95

p.96

Figure I-1.6. From p.81 to 96 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

Figure I-1.7. From p.97 to 112 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

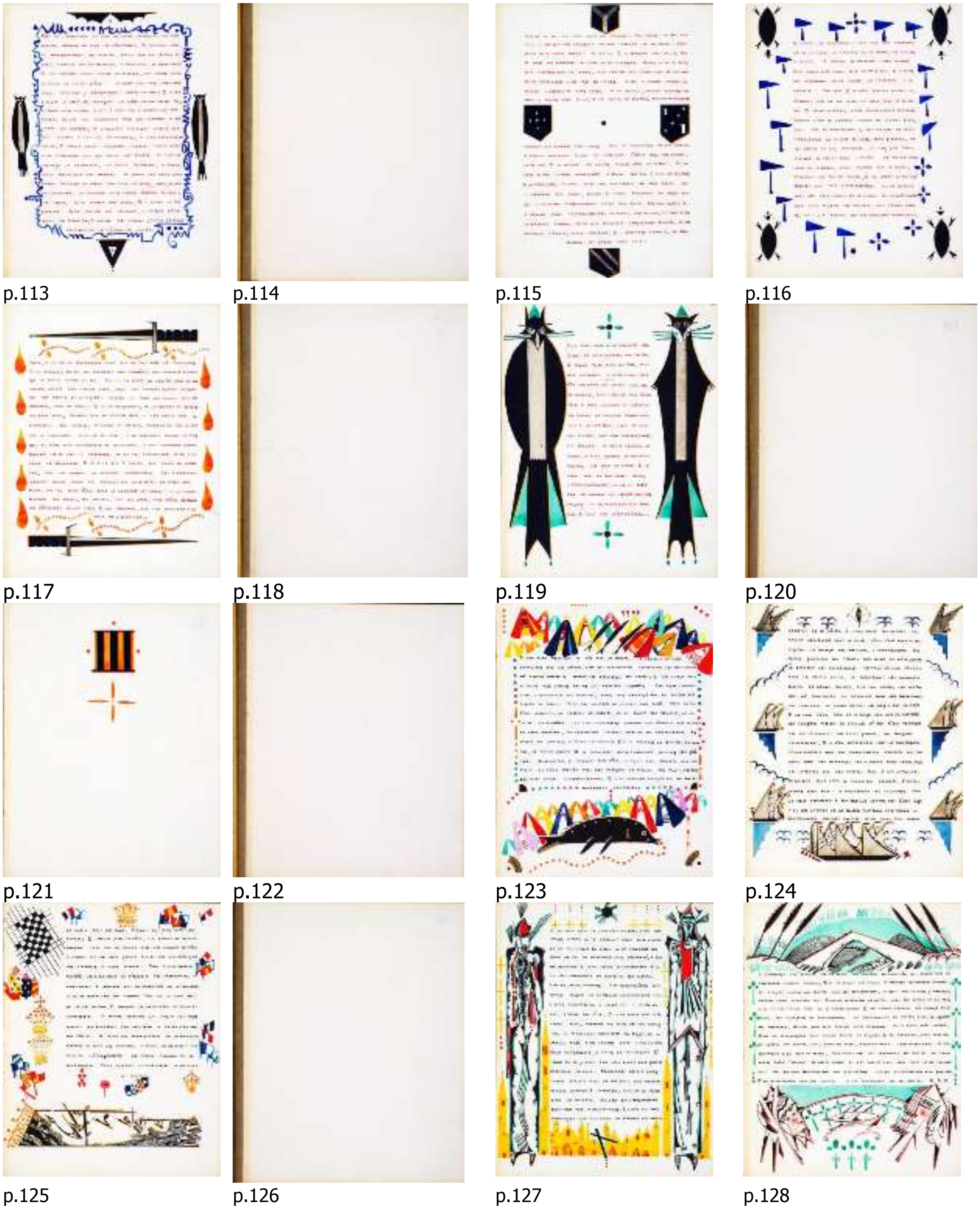


Figure I-1.8. From p.113 to 128 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

Figure I-1.9. From p.129 to 143 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

A1.2 – Saint Julian the Hospitaller

Saint Julian the Hospitaller's day feast is celebrated on August 31 in Macerata (Italy), where this saint is patron[312]**.** The author Maria Filomena Molder, citing Marcel Schwob in the preface written for the Luc-Olivier Merson's illustrated version of *La Légende*, mentioned that:

> *Jacques de Voragine indicates his feast day to be January the 27th, but the feast is usually celebrated the 20th. In Sicily, Italy, and in Belgium, however, the feast day is set at February the 12th, and near Barcelona, at August the 28th* [Molder 2006b, 369].

Moreover, about the hagiography of Saint Julian the Hospitaller, very little is known. Dictionaries and books about saints' hagiographies, as well as the stained glass widow of Rouen find meeting points with Jacques Voragine's narration in *La Légende Dorée* [The Golden Legend]:

> *[Julian] who unwittingly killed both his parents. When (this) Julian, noble by birth, was young, he went out one day to hunt and began to chase a stag whose trail he had picked up. Suddenly, by the will of God, the stag turned to face him and said: 'Are you tracking me to kill me, you who are going to kill your father and mother? Filled with dread at hearing his, and fearing that what he had heard from the stag might indeed happen to him, he left everything and went away secretly. Having reached a very remote region he took service with a prince, and carried on so manfully in wartime and peacetime that the prince dubbed hum a knight and gave him a widow, a noblewoman, in marriage with a castle as dowry. Meanwhile Julian's parents, deeply saddened by the loss of their son, wandered everywhere in search of him and in time reached the castle where Julian made his home. As it happened, Julian was away, but his wife met them and asked who they were. They told her all about their son, and she realized that they were her husband's father and mother – I think because she had often heard the same story from her spouse. She therefore welcomed them cordially and, for love of them, left her husband's bed to them and slept in another room. In the morning she went to church. Julian, arriving home, went to his bedroom to awaken his wife. Finding a couple asleep in his bed and supposing that they were his wife and her lover, he silently drew his sword and killed them both. Then he went out of the castle and saw his wife on her way home from church. Surprised, he asked her who the couple were whom he had found in his bed, and she said: ´They are your parents, they have been looking for you for the longest time, and I settled them in your bed'. At this news Julian almost fainted and, weeping bitterly, said: 'Woe is me, wretch that I am, what shall I do now? I have slain my dear, dear parents! See… I have tried so hard to escape the stag's prediction, and now I have fulfilled it in this horrible way! But now, sweet sister, farewell! I shall not rest until I know that God will accept my penance!' But his wife responded: "Far be it from me, dearest brother, to desert you and let you go away without me! I have shared your joy, now I shall be with you to share your sorrow!' They set out together and came to a broad river where many people were in danger of their lives. There they established a very large hospice in which they might work out their penance. They never failed to give transport to any who wished to cross the river, and received all poor folk kindly in their hospice. A long time passed, and one freezing night, when Julian, tired out, was getting some rest, he heard a plaintive voice calling his name and begging in the most doleful tones for transport. Quickly rising and going out, he found the man almost perishing from the cold, carried him into the house, lit*

[312]http://www.diocesimacerata.it/; Last accessed on February 11, 2017.

a fire, and tried to warm him. But the stranger did not respond, and Julian, fearing that he might die, put him in his own bed and carefully covered him up. In a short while the stranger, who had looked so infirm and almost leprous, rose splendid in mid-air and said to his host: 'Julian, the Lord sent me to tell you that he has accepted your penance, and that both of you will, in a little time, find rest in the Lord'. The messengers disappeared and not long thereafter Julian and his wife, full of good works and almsgiving, went to their eternal rest [Voragine *et al.* 2012, 127].

Figure I-2.1. *On the left:* Church of *Saint Julien le Pauvre* (Paris).
On the right: Bas *relief* representing Saint Julian the Hospitaller
(Located in 42 Rue Galande, 75005 Paris, France, near the church of *Saint Julien le Pauvre*).

References:

Molder, M.F. "*La Légende de Saint Julien l'Hospitalier* de Flaubert e Amadeo de Souza-Cardoso." In *Amadeo de Souza-Cardoso, La Légende de Saint Julien l'Hospitalier de Flaubert* (Facsimile Edition; deluxe edition), 11-50. Lisbon: *Centro de Arte Moderna*, FCG, 2006b.

Voragine, J.; Ryan, W.G.; Duffy, E.; *The Golden Legend: Readings on the Saints*. New Jersey: University Press, 2012.

A1.3 – The stained glass windows of the cathedral of Rouen[313] (France) – Saint Julian

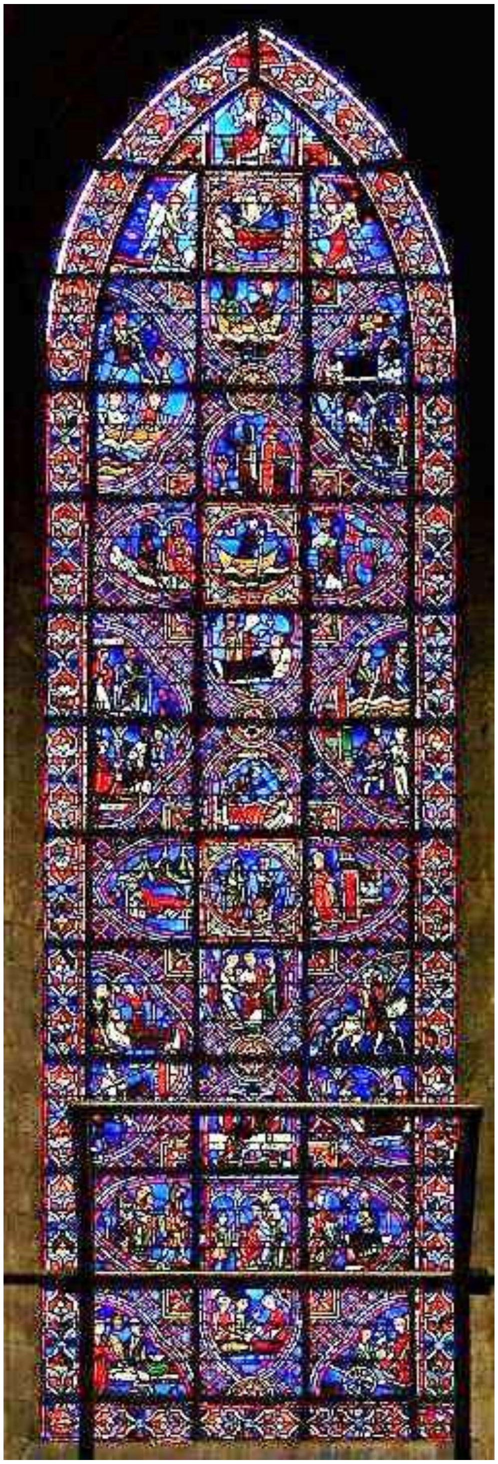


Figure I-3.1. *On the left:* Stained glass widow of Saint Julian the Hospitaller (Cathedral of Rouen) (c.1280/1290). *On the right:* The same representation by Langlois (1832) [Biasi 1999, 182].

[313]Source of the images presented: *The Medieval Stained Glass Photographic Archive* (Last access on February 11, 2017).

Figure I-3.2. The fishmongers (panels 1 to 3) [bottom].

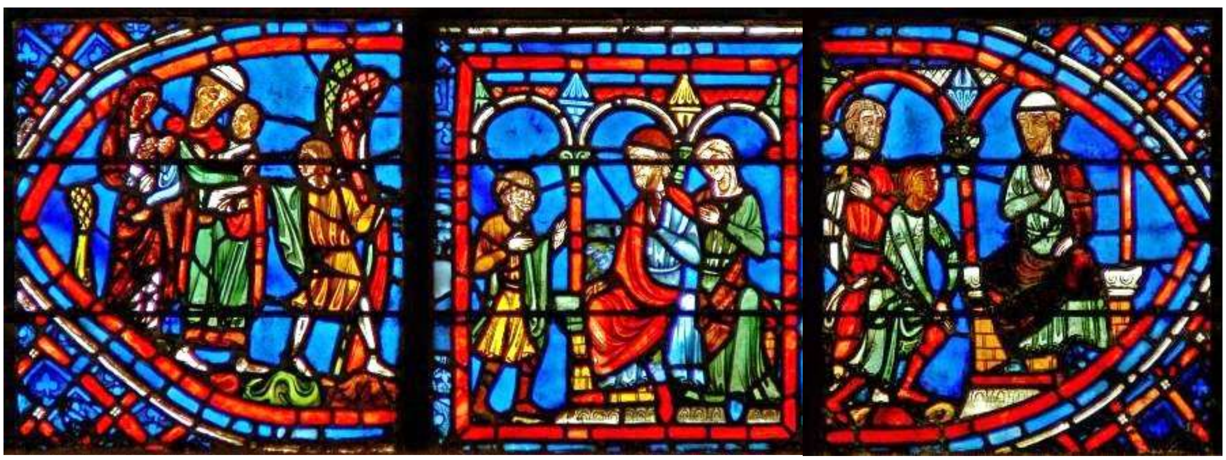


Figure I-3.3. *From left to right*: Julian's childhood/ He is told he will kill his parents/ He avoids them by going away (panels 4 to 6).

Figure I-3.4. *From left to right*: Julian on horse/ serving his master/ who fells hill (panels 7 to 9).

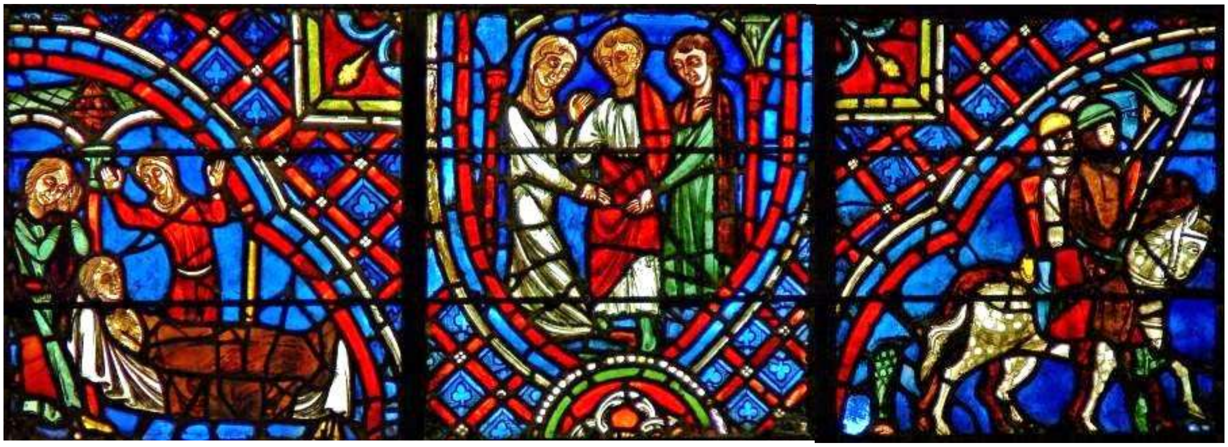


Figure I-3.5. *From left to right*: Julian's master dies / he marries his widow/ and goes off to war (panels 10 to 12).

Figure I-3.6. *From left to right*: Julian rests in his tent/his parents come looking for him /His wife welcomes them (panels 13 to 15).

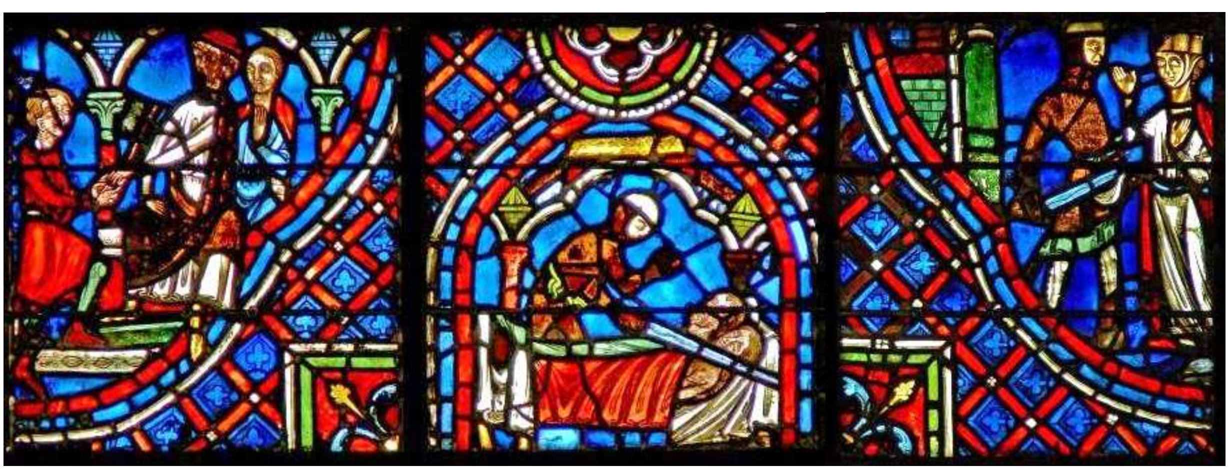


Figure I-3.7. *From left to right*: She lets Julian's parents sleep in her bed/Julian comes back and finding a couple in his bed thinks his wife is committing adultery/Julian mistakenly kills his parents but his wife appears and tells him what he has done (panels 16 to 18).

Figure I-3.8. *From left to right*: Julian leaves the house with his wife to do penance/ He founds an hospital/and becomes a boatman (panels 19 to 21).

Figure I-3.9. *From left to right*: Rising from his bed, Julien is summoned to the other side of the river/ Crosses the river/and finds Christ (panels 22 to 24).

Figure I-3.10. *From left to right*: Christ joins him in the boat/ then he returns to his waiting wife holding a light for him/ Christ speaks with them (panels 25 to 27).

Figure I-3.11. *From left to right*: The devil tempts Julian and tries to seduce his wife as well (panels 28 to 30).

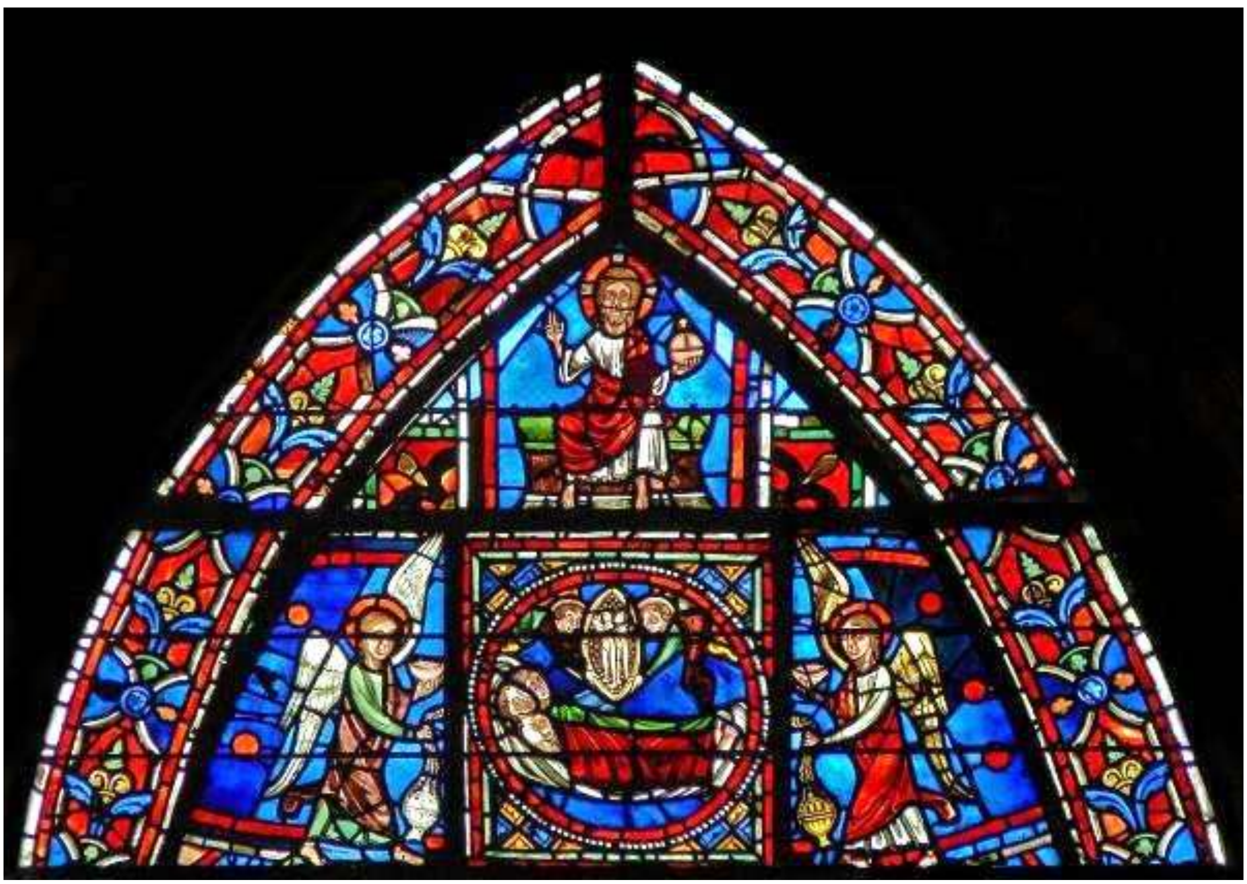


Figure I-3.12. They resist the devil, die and go to Heaven (panels 31 to 34) [top].

References:

Biasi, P.M. "Introduction." In *Flaubert, Trois Contes*, 5-25. Paris: Librairie Générale Française, 1999.

A1.4 – Amadeo's paintings related with *La Légende*

Figure I-4.1. *On the left:* p. 30 of *La Légende de Saint Julien l'Hospitalier*.
On the right: Le Prince et la Maute (1912), MG-MC.

Figure I-4.2. *On the left:* p. 45 of *La Légende de Saint Julien l'Hospitalier*.
On the right: Corpus Christi Procession (1913) and, in the bottom, a detail, MG-MC.

Figure I-4.3. *Les cavaliers* (1912-1913).
Source: Centre Georges Pompidou/Musée National d'Art Modern, Paris website:
www.centrepompidou.fr

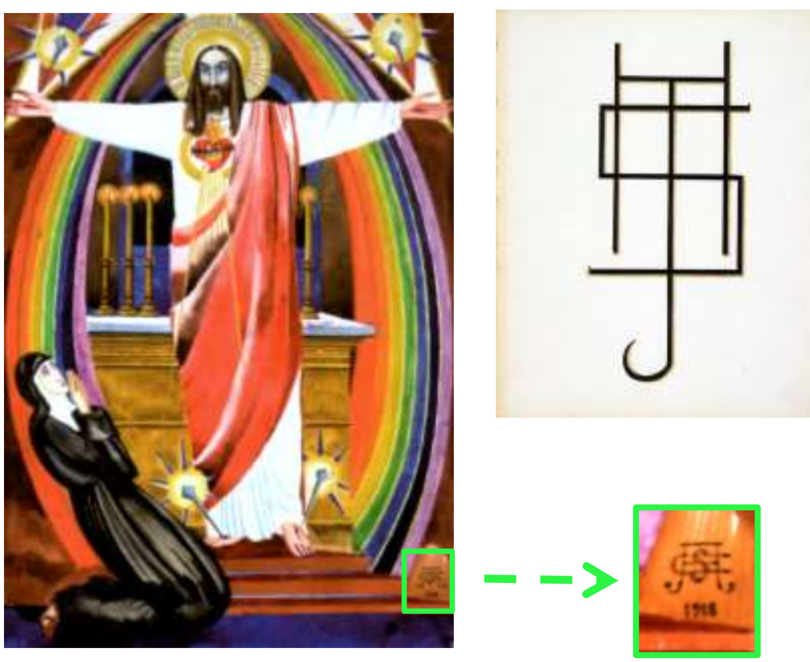


Figure I-4.4. *On the left: Sacred Heart of Jesus* (1918) [Freitas 2006b].
On the right: p. 15 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

References:

Freitas, H. *Exhibition Catalogue Diálogo de Vanguardas [Avant-Garde Dialogues]*, edited by H. Freitas, 69-364. Lisbon: FCG, 2006b.

A2.1 **– Maria Filomena Molder's observations**

Figure II-1.1. Multiplicity of Amadeo's signatures used by Amadeo until 1913 [Molder 2006b, 51].

Figure II-1.2. Amadeo's *totem* used during the beginning of his career as signature.
Source: Album *XX Dessins* (1912), MG-MC.

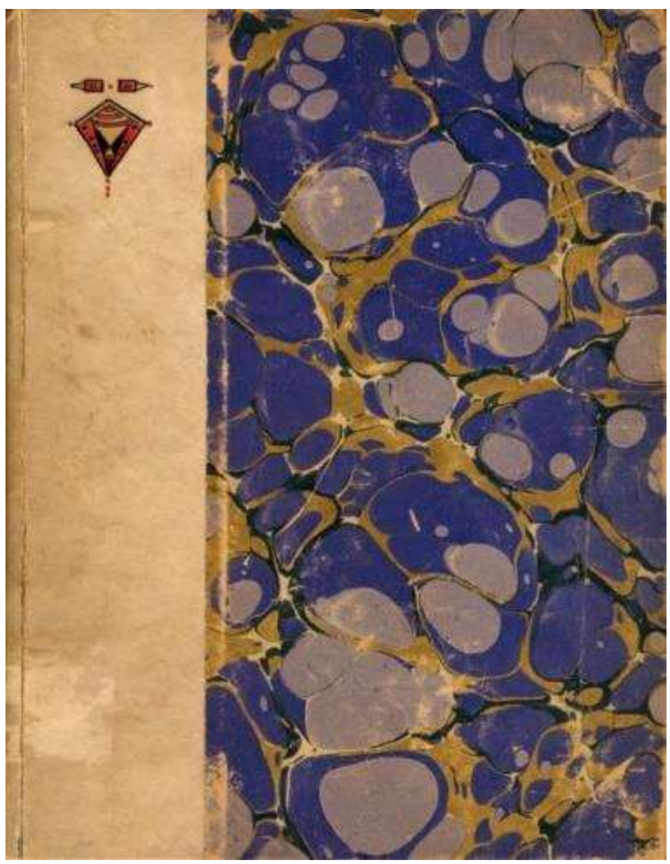


Figure II-1.3. Bookbinding of Amadeo's exemplary from his personal library of Manuel Laranjeira. 1912.
Commigo – versos de um solitário. Coimbra: Depósito Geral, BA-FCG.

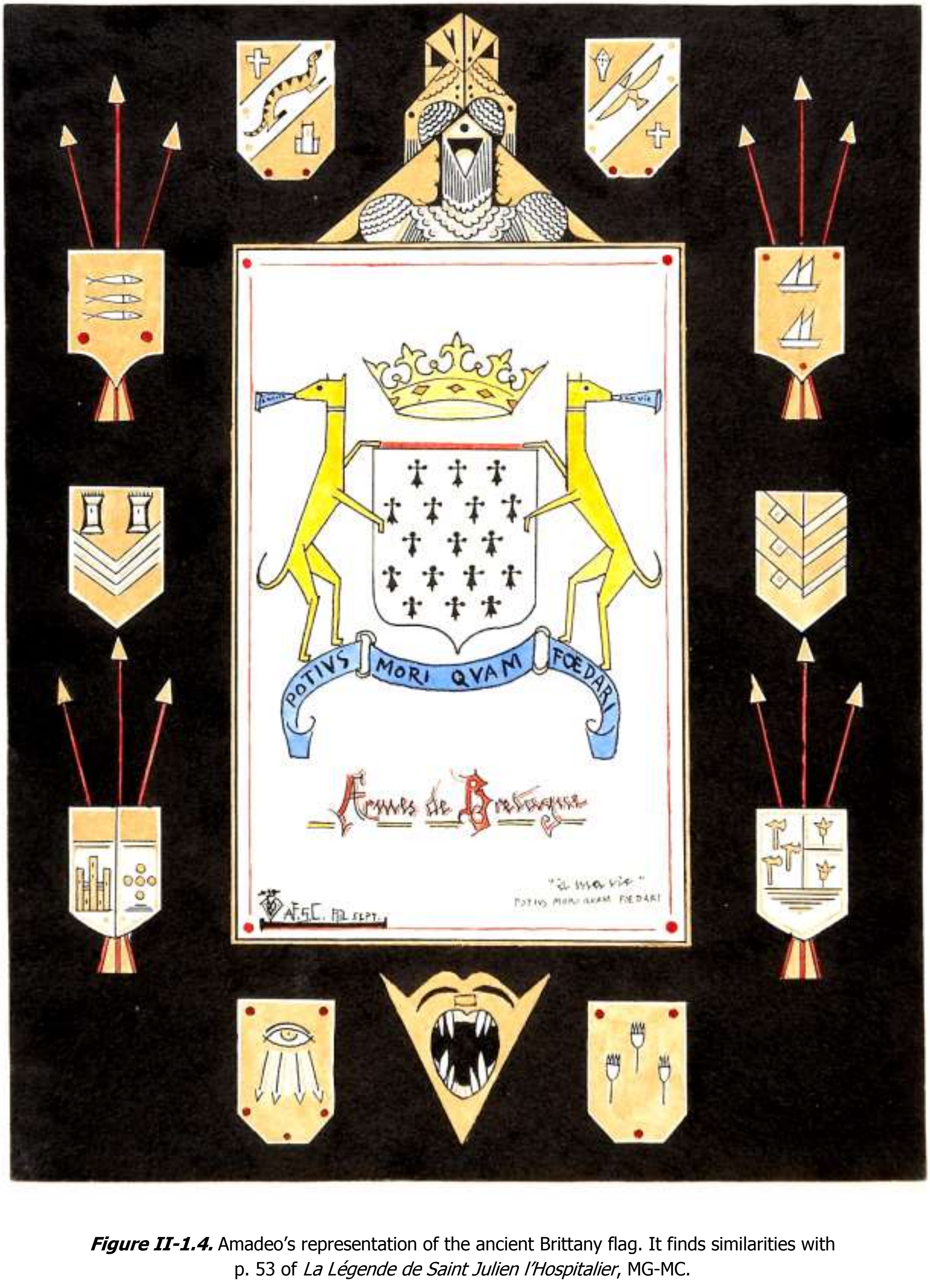


Figure II-1.4. Amadeo's representation of the ancient Brittany flag. It finds similarities with p. 53 of *La Légende de Saint Julien l'Hospitalier*, MG-MC.

Figure II-1.5. Amadeo's motto *Accomplir c'est vaincre* present in his *ex-libris* [Molder 2006b, 34].

Figure II-1.6. Amadeo's signature with *pochoir* used since 1914 [Freitas 2006b].

References:

Freitas, H. *Exhibition Catalogue Diálogo de Vanguardas [Avant-Garde Dialogues]*, edited by H. Freitas, 69-364. Lisbon: FCG, 2006b.

Molder, M.F. "*La Légende de Saint Julien l'Hospitalier* de Flaubert e Amadeo de Souza-Cardoso." In *Amadeo de Souza-Cardoso, La Légende de Saint Julien l'Hospitalier de Flaubert* (Facsimile Edition; deluxe edition), 11-50. Lisbon: *Centro de Arte Moderna*, FCG, 2006b.

***A2.2* – Data-set of modern artists' books in France until 1912**

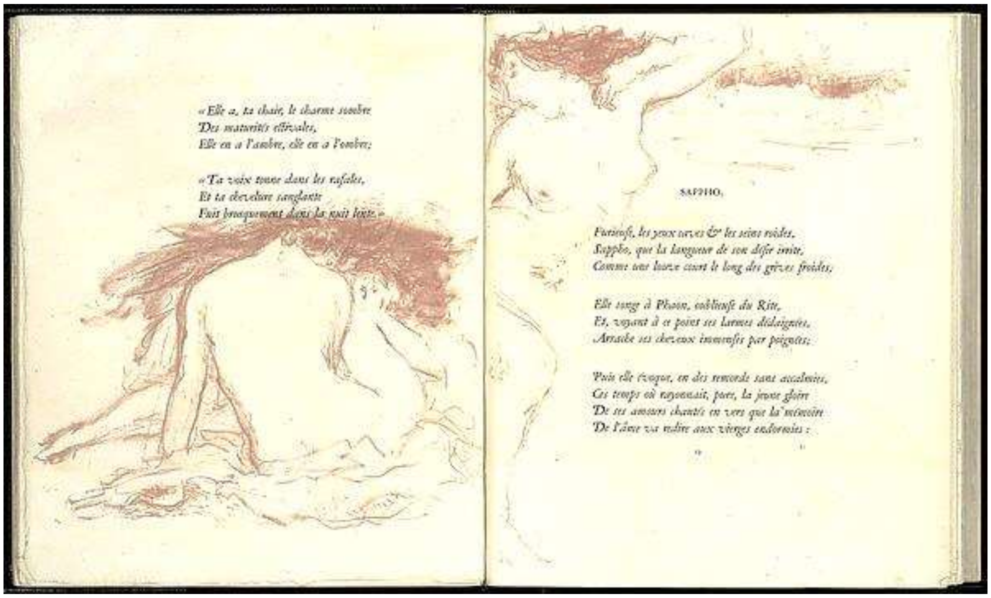


***Figure II-2.1.* Pierre Bonnard/ Paul Verlain**
Parallèlement. Paris: Ambroise Vollard, 1900; Lithographs in pink sanguine.
Source: The Metropolitan Museum of Art website: www.metmuseum.org.

***Figure II-2.2.* Auguste Rodin/Octave Mirbeau**
Le Jardin des supplices. Paris: Ambroise Vollard, 1902; Lithographs.
Source: Musée Rodin website: www.musee-rodin.fr/

Figure II-2.3. **André Derain/Guillaume Apollinaire**
L'Enchanteur pourrissant. Paris: Daniel-Henry Kahnweiler, 1909; Woodcuts.
Source: MoMA website: www.moma.org.

Figure II-2.4. **Raoul Dufy/Guillaume Apollinaire**
Le Bestiaire, ou Cortège d'Orphée. Paris: Deplanche, 1911; Woodcuts.
Source: Fine Arts Museums of San Francisco website: www.artfamsf.org.

Figure II-2.5. **Pablo Picasso/Max Jacob**
Saint Matorel, Paris: Daniel-Henry Kahnweiler, 1911. Etchings.
Source: Museo Reina Sofia website: www.museoreinasofia.es.

Figure II-2.6. **André Derain/Max Jacob**
Les Oeuvres burlesques et mystiques de Frère Matorel mort au couvent, Paris: Daniel-Henry Kahnweiler, 1912. Woodcuts.Source: Fine Arts Museums of San Francisco website: www.artfamsf.org.

- **Some of Amadeo’s drawings for the album *XX Dessins* (1912)**

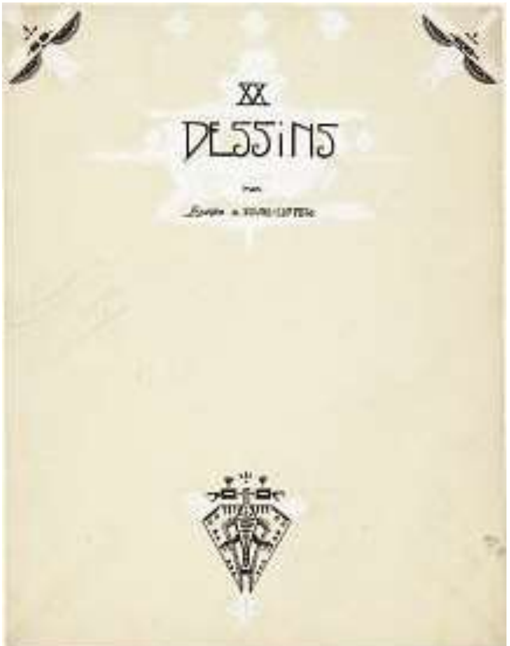


Figure II-2.7. *On the left*: Frontispiece for the album *XX Dessins* (1912), MG-MC.
On the right: ‘Le Moulin’ [The Windmill] (Drawing nº15) for the album *XX Dessins* (1912), MG-MC.

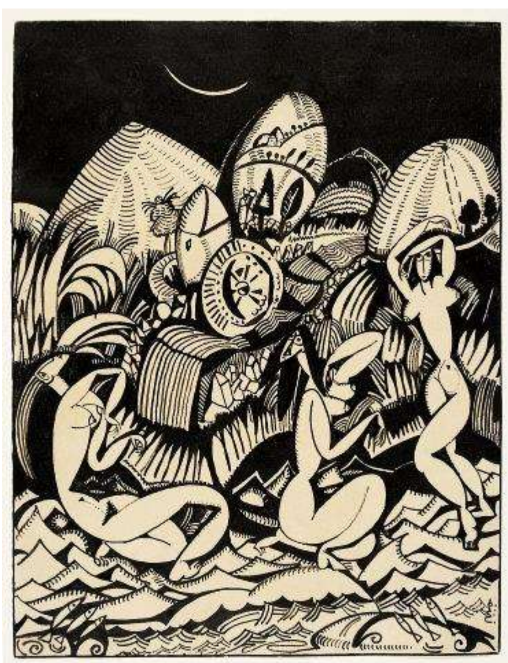


Figure II-2.8. *On the left*: ‘Le bain des Sorciéres’ (Drawing nº10) for the album *XX Dessins* (1912), MG-MC.
On the right: ‘Les chevaux du Sultan’ [The Sultan’s Horses] (Drawing nº19) for the album *XX Dessins* (1912), MG-MC.

A2.3 – Russian *avant-garde* books c. 1912

Figure II-3.1. **A. Kruchenykh, V.Khlebnikov/N.Goncharova**
Mirskontsa [Worldbackwards]. Moscow: 1912 [Hellyer 2006, 91].

Figure II-3.2. **A. N.Goncharova**
Misticheskie obrazy voiny [Mystical images of war]. Moscow: 1914.
Lithograph [Hellyer 2006, 98].

References:

Hellyer, P. (ed) *A Catalogue of Russian Avant-Garde Books 1912-1934 and 1969-2003* (Second enlarged edition with illustrations). London: The British Library, 2006.

A2.4 – Other details from Amadeo's artist's book

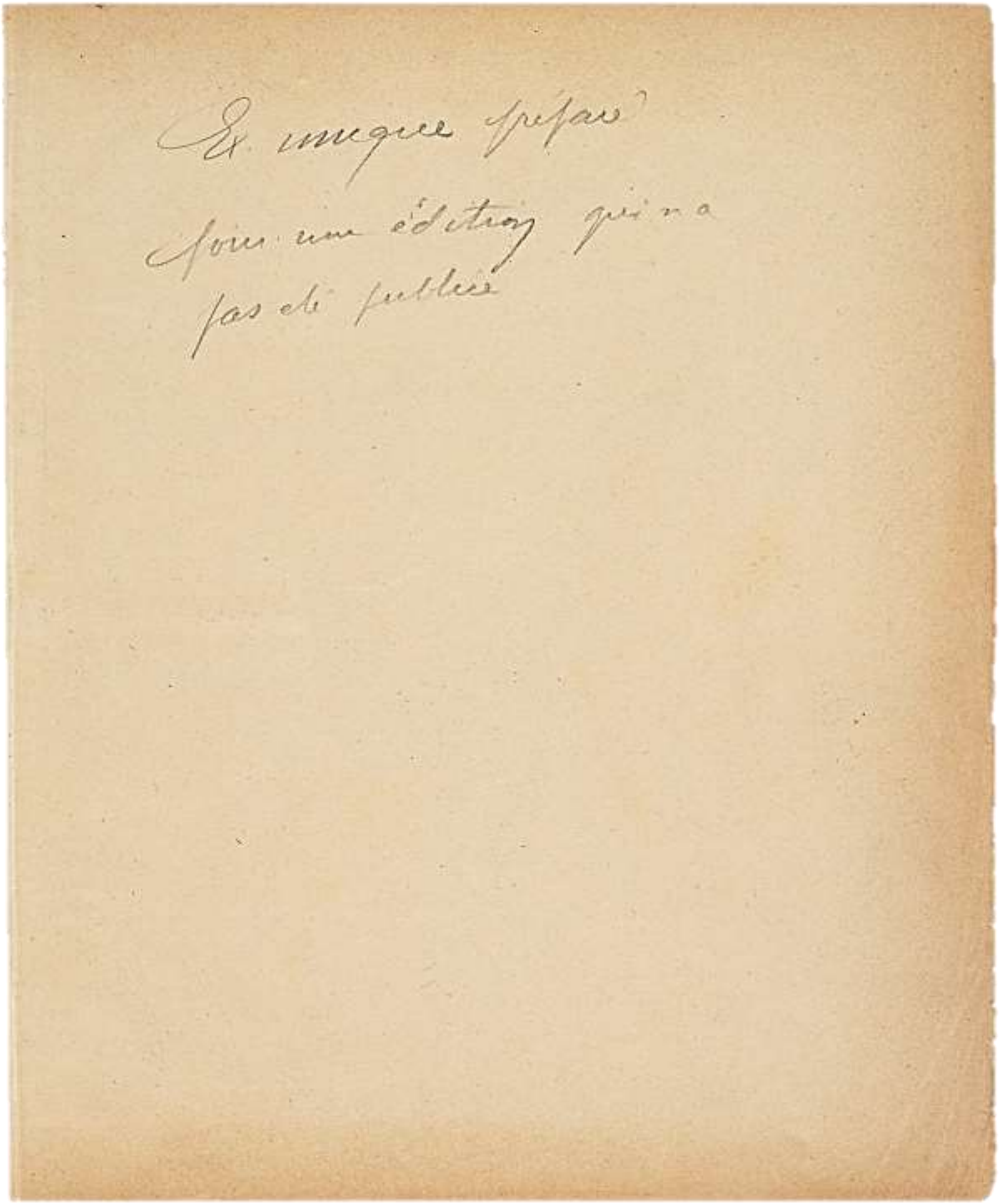

Ex. unique préparé
pour une édition qui n a
pas été publiée

Figure II-4.1. Fly-leaf from *La Légende de Saint Julien l'Hospitalier*, MG-MC.

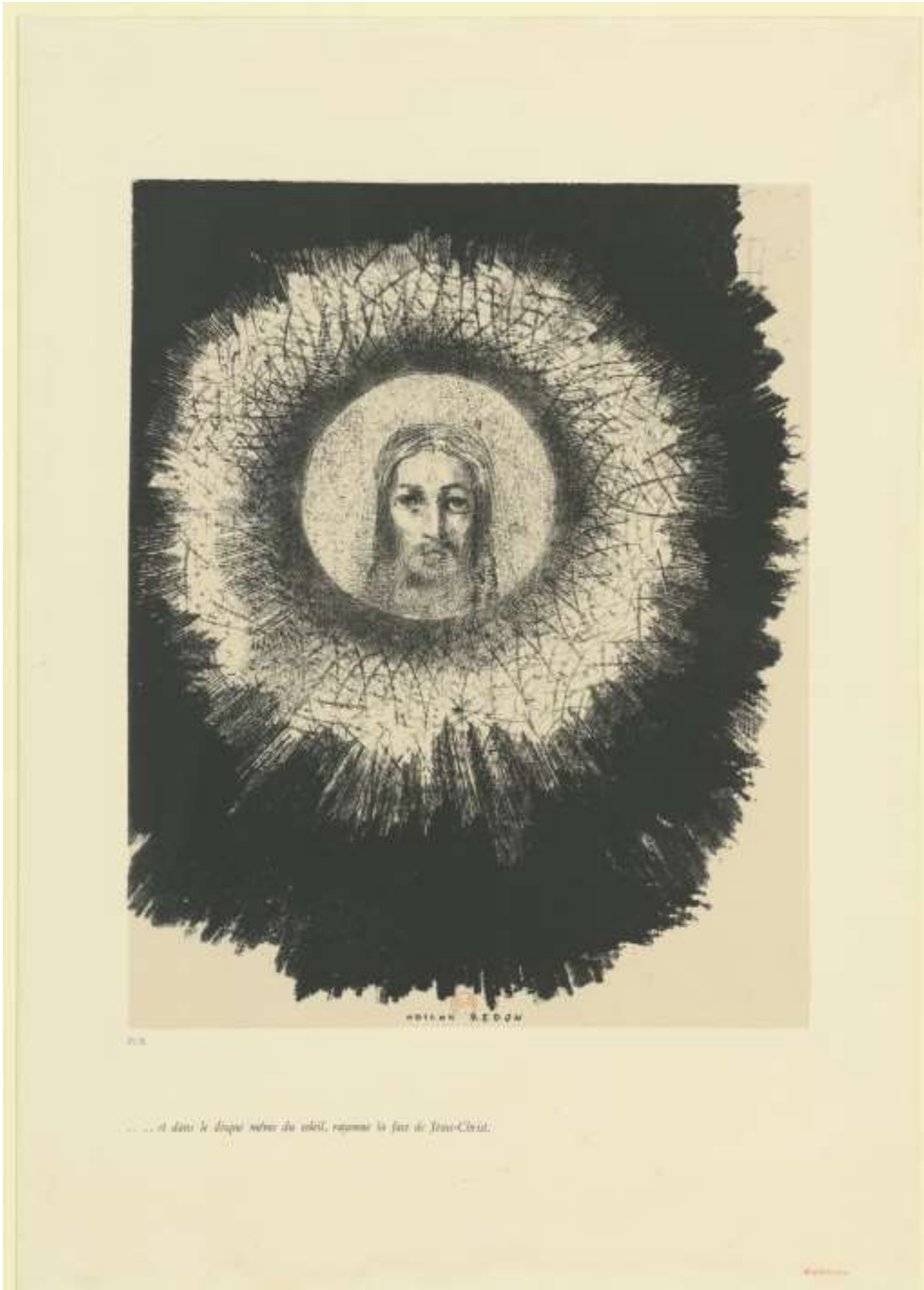


Figure II-4.2. **Odilon Redon/Gustave Flaubert**
La Tentation de Saint Antoine (Jesus Christ), ed. 1888 (Illustrated book). Lithographs.
Source: BNF website: gallica.bnf.fr

***A2.5* – Example of a bibliophile book**

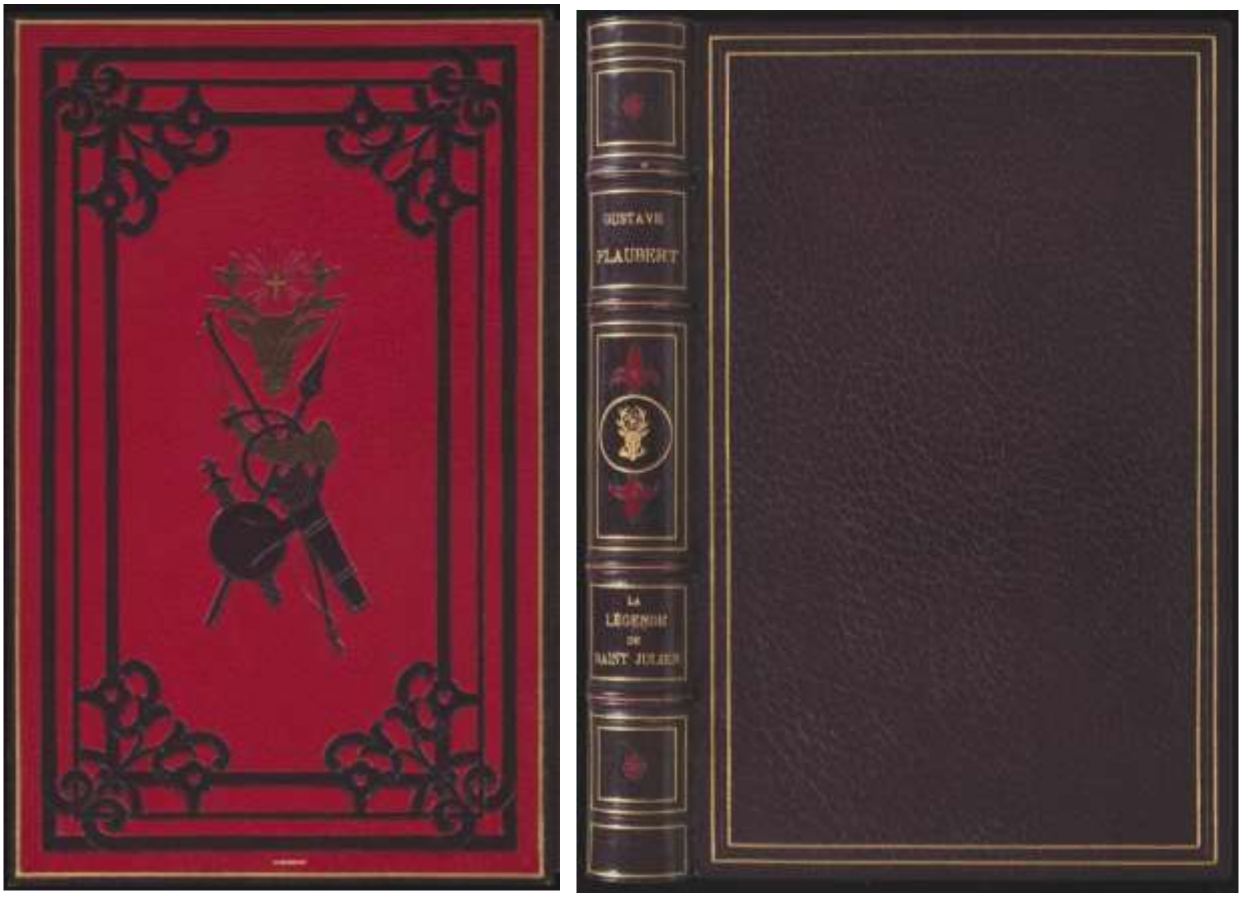


Figure II-5.1. Exemplary of Flaubert's *La Légende de Saint Julien l'Hospitalier* which belonged to Calouste Gulbenkian (1869-1955), MG-FC.

❖ **Example of an illustrated book in watercolour paint**

Figure II-5.2. Guy de Maupassant, *La Maison Tellier* (1897) (336 x 271 mm) (bookbinding in vellum by Émile Carayon with watercolours by Henriot, MG-FC.

A2.6 – Examples of handwritten books from middle 20th century artists' books

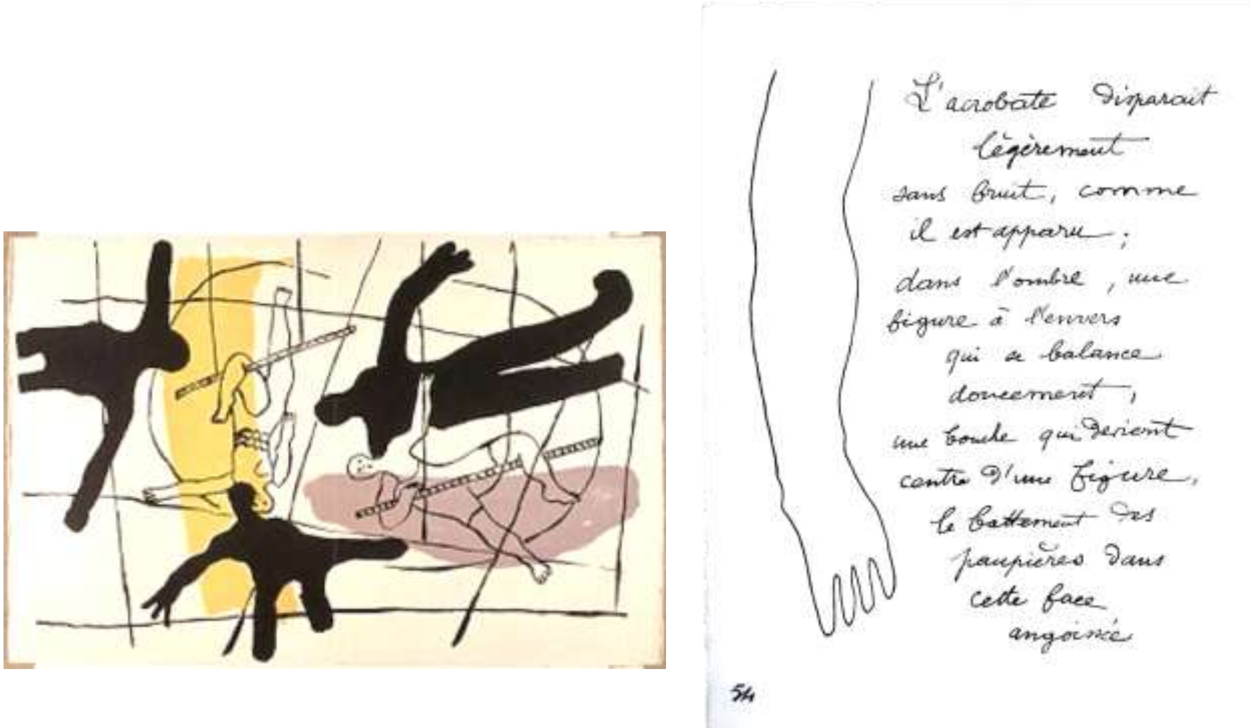


Figure II-6.1. Fernand Léger, *Cirque*, Paris: Tériade Editeur 1950 (First edition) [Lithographs] [Castleman 1994, 95].

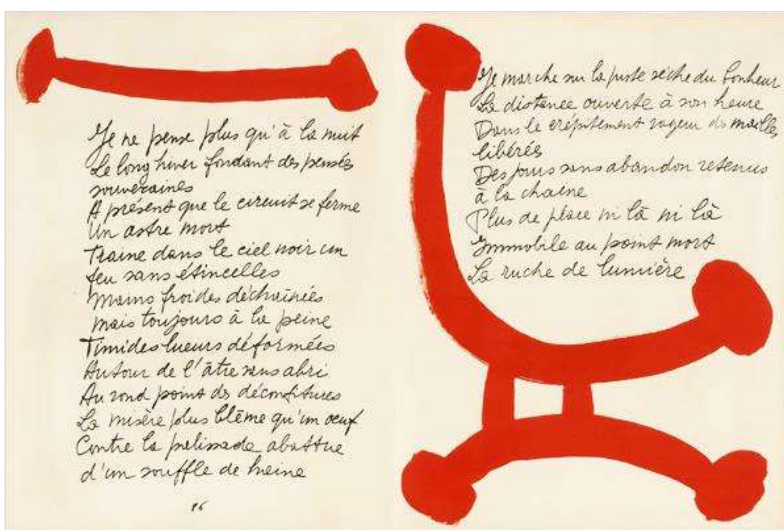


Figure II-6.2. Pablo Picasso/Pierre Reverdy, *Le Chant des morts*, Paris: Tériade Editeur, 1948 (First edition) [Lithographs] [Castleman 1994, 129].

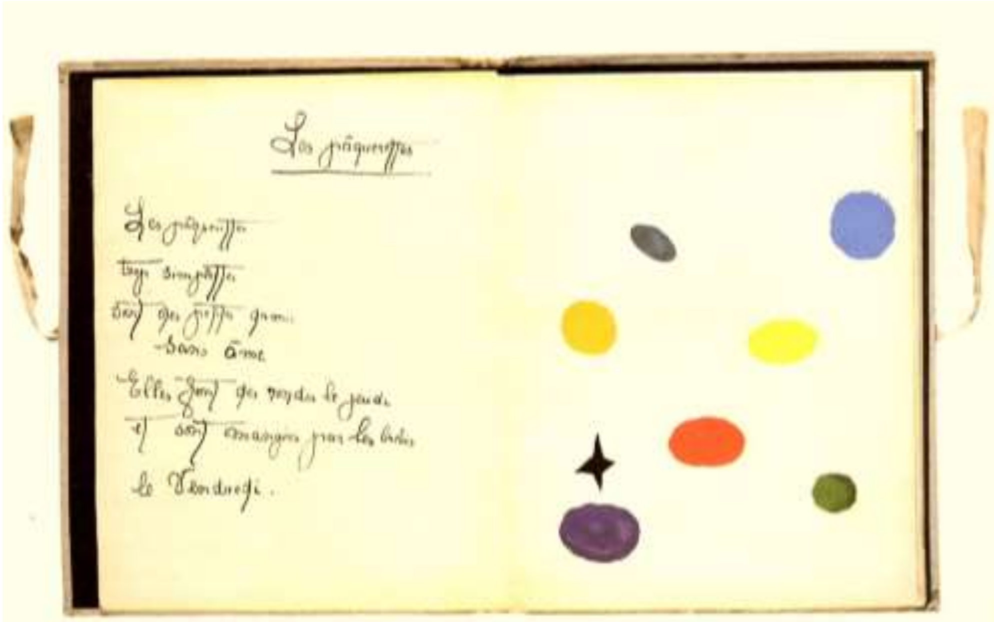


Figure II-6.3. Joan Miró/Lise Hirtz, *Il était une petite pie(Les Pâquerettes)*, Paris: Éditions Jeanne Bucher, 1928
[*pochoir* illustrations on *japon* after gouaches of Miró]
[Johnson and Stein 2001, 172].

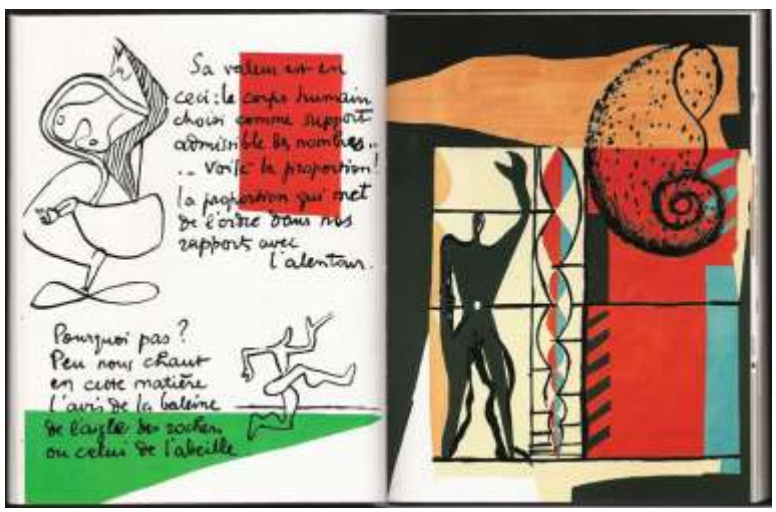


Figure II-6.4. Le Corbusier [Charles-Édouard Jeanneret]
Le Poème de l'angle droit, Paris: Tériade Éditeur, 1955 [lithographs] [Johnson and Stein 2001, 220].

References:

Castleman, R. *A century of artists books*. New York: MoMA, 1994.

Johnson, R.F. and Stein, D. *Artists' Books in the Modern Era 1870-2000, The Reva and David Logan Collection of Illustrated Books*. San Francisco: Fine Arts Museums of San Francisco, 2001.

A2.7 – Inside the *Château de Keriolet*, Concarneau

Figure II-7.1. Postcard from Amadeo's time showing *La Salle des Gardes* and its chimney.

Figure II-7.2. *Salles des Gardes* of the *Château de Keriolet*, nowadays. Photo credit: Monique Dupuy-Kiefer.

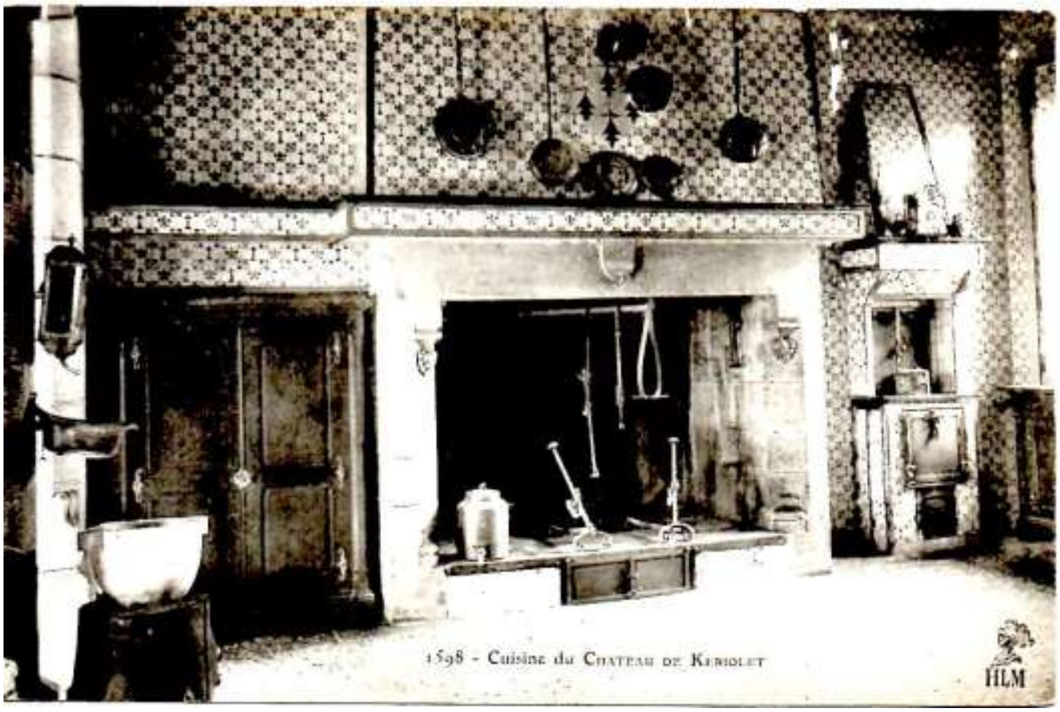


Figure II-7.3. Postcard from Amadeo's time showing the kitchen of the *Château de Keriolet*.

Figure II-7.4. Kitchen of the *Château de Keriolet*, nowadays*.* Photo credit: Monique Dupuy-Kiefer.

***A2.8* – Port of Concarneau**

Figure II-8.1. Paul Signac, *Setting Sun. Sardine Fishing*. Adagio.
Opus 221 from the series The Sea, The Boats, Concarneau, 1891, oil on canvas.
Source: MoMA website: www.moma.org/

Figure II-8.2. Paul Signac, *Evening Calm, Concarneau*. Opus 220 (Allegro Maestoso), 1891, oil on canvas.
Source: The Metropolitan Museum of Art website: www.metmuseum.org/

Figure II-8.3. Port of Concarneau, c. 1900. Photo credit: Musée d'Orsay, Paris.

Figure II-8.4. *On the left:* Alfred Wolmark, *Fisher Girl of Concarneau*, 1911, oil on canvas. Source: Tate website: www.tate.org.uk; *On the right:* Mathurin Janssaud, *Sunset in a Breton port (Concarneau)*, between 1857-1940, pastel on cardboard. Photo credit: Musée d'Orsay, Paris.

A2.9 – Russian religious iconography

Figure II-9.1. *On the left: La Légende* p. 24, MG-MC.
On the right: Ulanov, Kirill, *Venerable Anthony of the Caves* (17th century),
Source: Tretyakov website: http://www.tretyakovgallery.ru/.

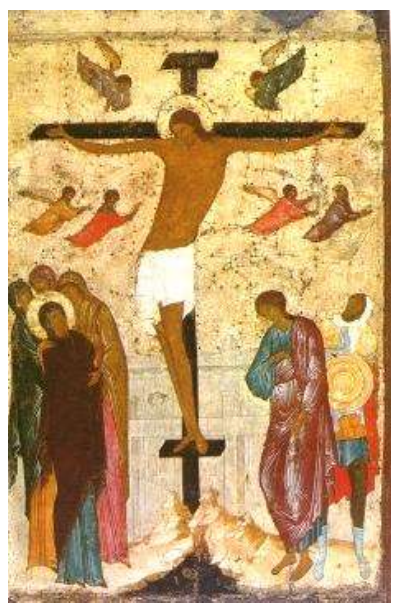


Figure II-9.2. *On the left: La Légende* p. 42, MG-MC.
On the right: Dionisy, *The crucifixion* (15th century),
Source: Tretyakov website: http://www.tretyakovgallery.ru/.

A2.10 – *Ex-votos*

Figure II-10.1. *Ex-votos* represented in a postcard sent to Amadeo by Otto Freundlich. Chartres 1914, BA-FCG.

A2.11 – Medieval Books of Hours

Figure II-11.1. *On the left: Annunciation* from a Book of Hours, c. 1400-1420 (*Cofre* nº22, fl.22), PNM.
On the right: La Légende: p.99, MG-MC.

Figure II-11.2. *On the left: Visitation* from a Book of Hours, c.1400 (IL42, fl.45), BNP.
On the right: La Légende: p.100, MG-MC.

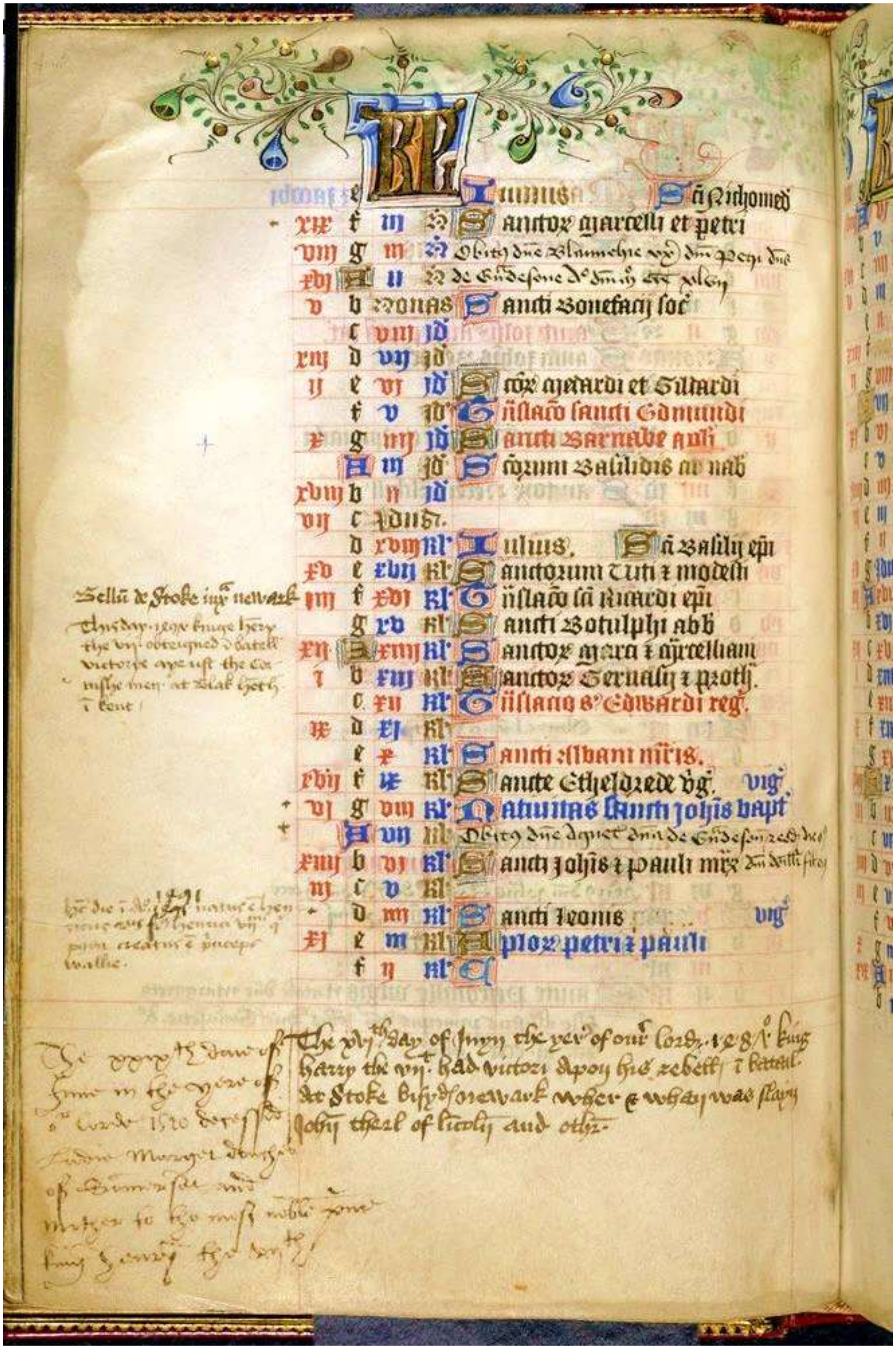


Figure II-11.3. Example of capital letters from a Book of Hours, 1489 (Shelfmark: Royal MS. 2A xviii, fl. 30v), BL.

_A2.12_ – Heraldry and visual contemporary poetry

ACADEMIA
HERALDICA
MADRID
PARIS

LAMBERT DE MONTOISON, Heraldo de Armes

Certifica y hace Constar en testimonio de la verdad ante los tribunales justicia, colegios, comisiones, y a cuantos el presente *Certificado* vieren, que en el *Real Archivo de España*, consta como NOBLE las Familias de Nunes, patronimico dos antiguos Senhores de la Castellania y Ducado de Burgos en Aragon.
— de Souza en Portugal, passada en España a la batalla de las Navas
— de Cardoso. linage oriundo de Portugal. Cuya Casa en España Venezia. Londres Inglaterra y America

Estas *Armas* son tal como van representadas y pintadas en el Registros Nacional de España, Portugal, Inglaterra.
y reproducidas aqui

En virtud de su NOBLEZA, Don Amadeo
Nunes de Souza Cardoso

podra usar de dicho *Escudo de Armas*, sin que se lo pueda impedir ningun tribunal ni jurisprudencia alguna y para que asi conste, donde convenga.

Damos a su demanda el presente *Certificado de Armas y Titulos*, de los cuales queda copia en nuestros archivos, f° n° 2270

Extracto: Archivo de l'academia Heraldica en esta muy Heroica Villa y Corte de Madrid. dias 2 y anno 1913. mes de april.
Sello n° 575.

Firmada y Sellada de nuestras armas.

Lambert de Montoison

Figure II-12.1. Amadeo's certificate of nobility, BA-FCG.

Figure II-12.2. Examples from the set of drawings referred to the heraldry of Brittany' cities carried out by Amadeo, MG-MC.

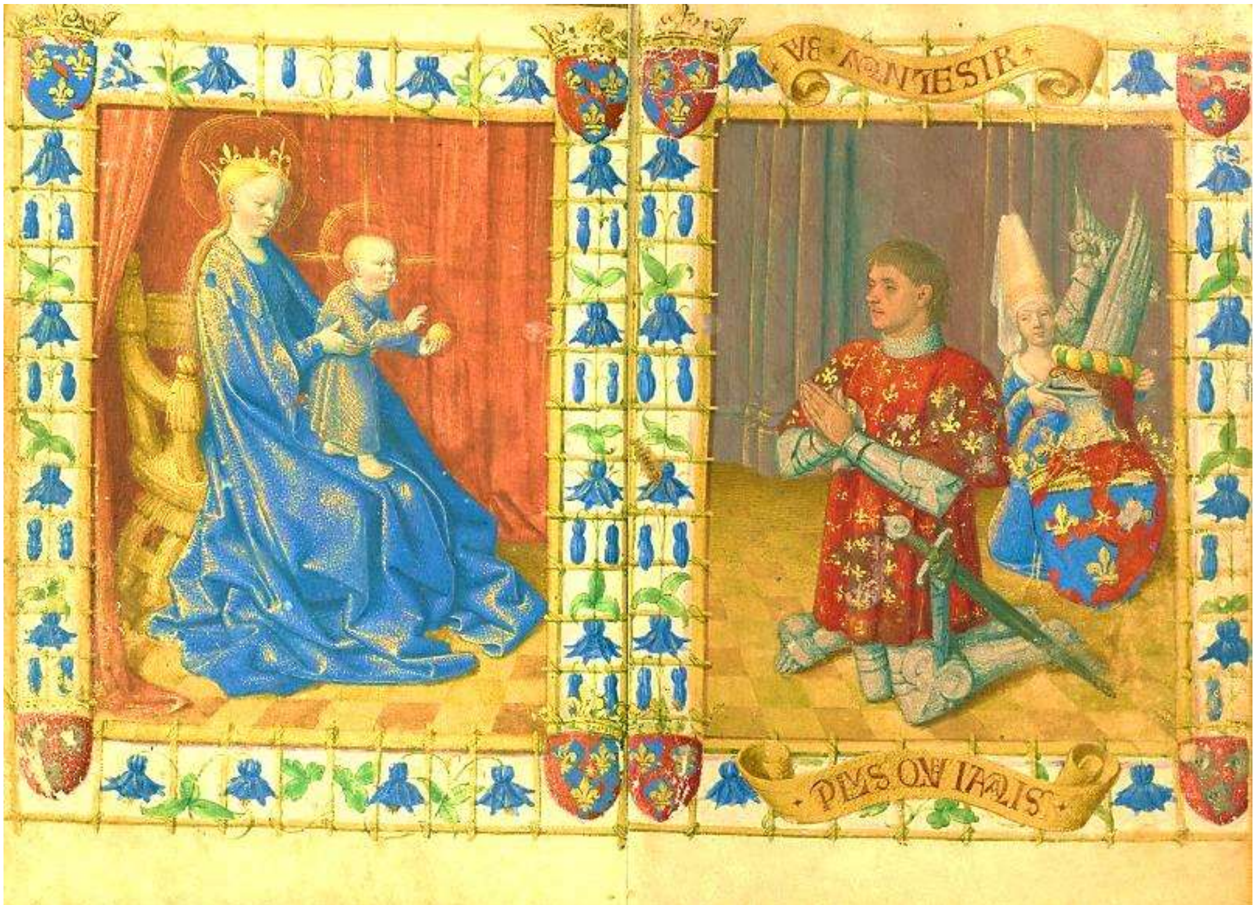


Figure II-12.3. Example of representations of coats of arms in a medieval book of hours, Paris, ca. 1455 (Ms. 7, fl.1v-2), The J. Paul Getty Museum. Source: http://blogs.getty.edu/

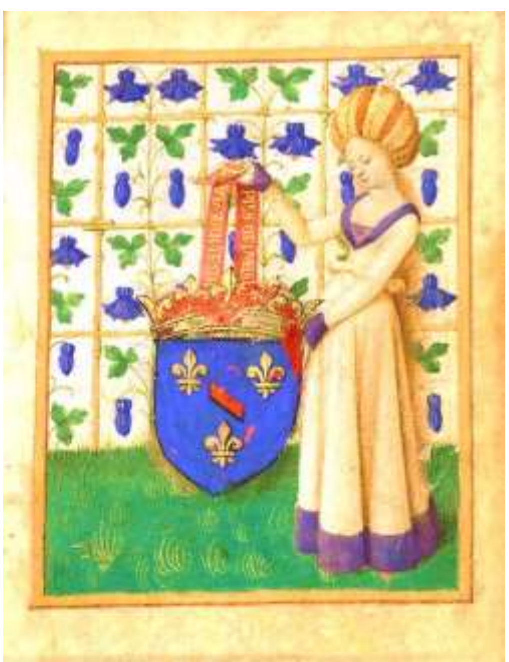


Figure II-12.4. Example of representations of coats of arms in a medieval book of hours, Paris, ca. 1455 (Ms. 7, fl. 1),The J. Paul Getty Museum Source: http://blogs.getty.edu/

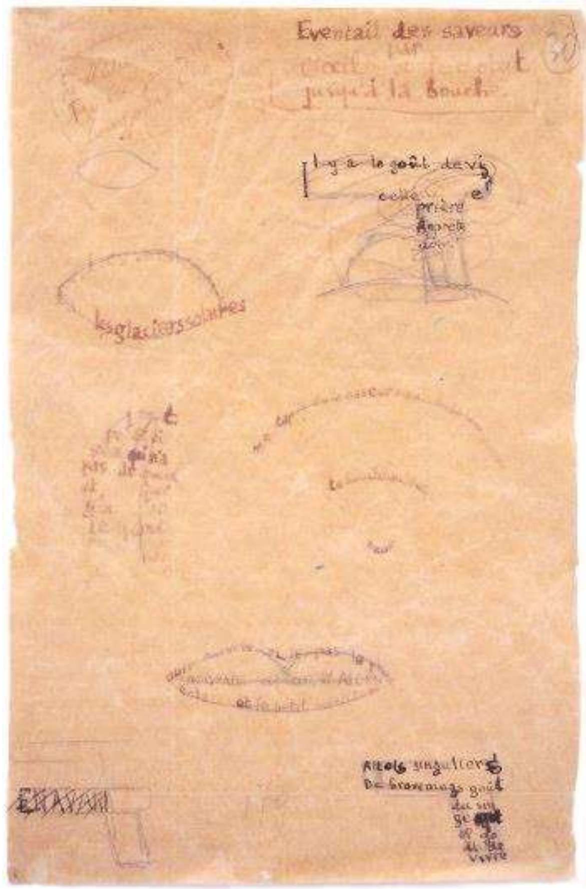


Figure II-12.5. Guillaume Apollinaire. *Revolver*. Drawing for the calligramme *Éventail des saveurs* [*A Range of Flavours*], 1917-18. Source: MoMA collection website: www.moma.org

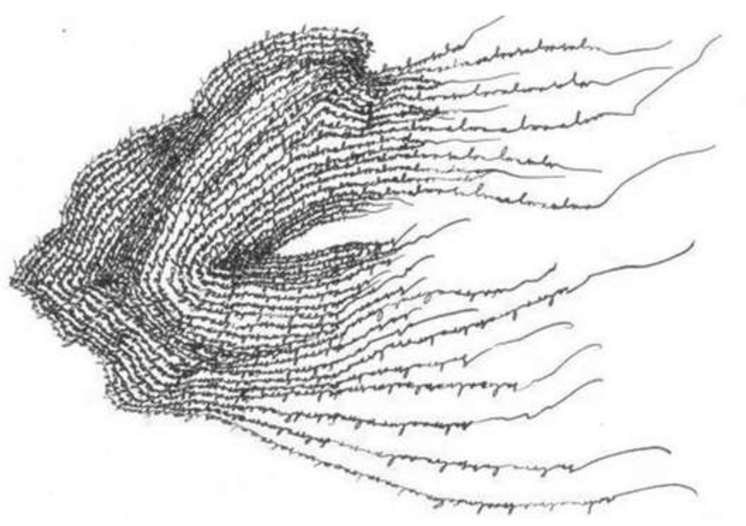


Figure II-12.6. Ana Hatherly, *Salvem a Alma!* [Save the Soul], 1997, MG-MC.

A3.1 – Equipment

Optical microscope

Observations by MO of fibres from the different papers present in the manuscript were carried out in an optical Zeiss Axioplan Z Imaging microscope with a Nikon digital camera DMX 1200 F and a mercury light source HBO 100 illuminator.

Stereo microscope

The optical analyses on the manuscript were carried out in a Leica MZ 16 stereomicroscope with a Leica digital camera Digilux 1, with fibre optic light Leica system Leica KI 1500 LCD.

A3.2 - Glossary on book's structure terminology

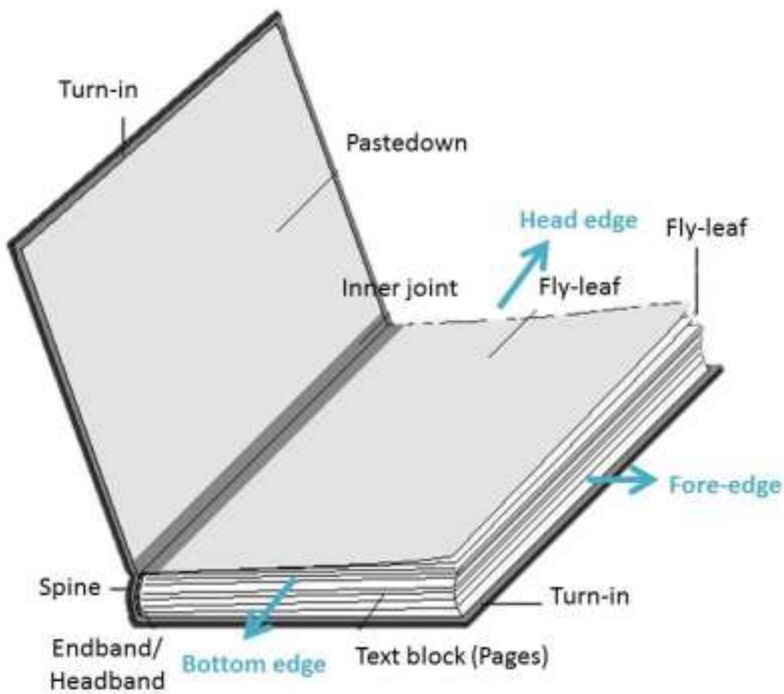


Figure III-2.1. Structure of book.

In *Bookbinding and the Conservation of Books – A Dictionary of Descriptive Terminology* (1982), Don Etherington and Matt Roberts describe the following terms used in ***Chapter 3*** of this dissertation:

Endpapers

The units of two or more leaves placed in the front and back of a book between its covers and text block. In rare instances the endpaper may consist of a single leaf. The endpaper at the front of the book is called the front endpaper, while the one at the back is called the off endpaper, or back endpaper. The leaf nearest the cover (…) is called the ***pastedown*** *, or board paper, and, along with the recto of the leaf facing it, may be coloured, marbled, ornamented; printed with maps, illustrations, scenes from the book, the motif of the library, etc.; or left blank. The leaf or leaves that are not pasted to the board are sometimes referred to as fly leaves, fly sheets, free fly leaves, or waste sheets.*

Fly-leaf

A leaf or leaves at the beginning and end of a book, being the leaf or leaves not pasted to the boards, or covers, of the book.

Guard

The guard consists of several strips of paper folded with the two open ends being folded back on the guard, either together or in opposite directions; the guard may be folded over in one direction on itself and the section sewn at either end, or it may be folded over in opposite directions on itself and one or two sections sewn to it, depending on the thickness of the sections and amount of sewing swell required. Generally, the paper used for the guard (before folding) should be one-fourth the thickness of the section, so that when it has been folded it will be of equal thickness. The reversed V technique is used if the paper of the book is too thick to be sewn in the usual manner, and if it is not possible or desirable to hinge the leaves on linen guards, such as in an album. In addition, such a guard may be required because there is writing in the folds of the sections which would be made inaccessible by the usual manner of sewing and binding. The reversed v-guard technique places considerable strain on the sewing thread and folds of the section, particularly if the guards throw out far from the spine. Also called 'meeting guard'.

Spine

Flexibility is a characteristic of the spine of the book which allows the book to open freely with minimum strain on the structure. The purpose of lining the spine is to support it and to impart a certain degree of rigidity, while still maintaining the necessary flexibility for proper opening; consequently the weight and stiffness of the spine lining material [fabric or paper] is of considerable importance.

Text block

The body of a book, consisting of the leaves, or sections, making up the unit to be bound, rebound, or restored. It excludes all papers added by the bookbinder, including board papers, endpapers, doublures, etc.

References:

Etherington, D. and Roberts, M., *Bookbinding and the Conservation of Books – A Dictionary of Descriptive Terminology* (1982), http://cool.conservation-us.org/don// (Last access on February 11, 2017).

Glossary on Paper Conservation, Hong Kong: Gothe-Institut Hong Kong, 2013.

Language of bindings: http://www.ligatus.org.uk/lob/alphabetical (Last access on February 11, 2017).

A 3.3 **- Deteriorated areas in the manuscript**

Figure III-3.1. Past-down and fly-leaf from *La Légende*, MG-MC.

Figure III-3.2. Fly-leaf (presenting darkening) from *La Légende*, MG-MC.

A3.4 - Phloroglucinol test

<u>Microchemical test</u>:

Solution A: 1 g phloroglucinol in 50 ml alcohol (ethyl or methyl).
Solution B: 25% hydrochloric acid solution.

Add phloroglucinol solution to material to be stained.

Let stand 1 minute. Add 1 drop hydrochloric acid solution. Leave for 5 minutes. To enhance the reaction, the material can be air dried and then rehydrated [Florian *et al.* 1990, 36].

<u>Results</u>: Identification of lignin in fibres from the fly-leaves and guards of *La Légende de Saint Julien l'Hospitalier*. The red colouration due to reaction indicates the presence of lignin.

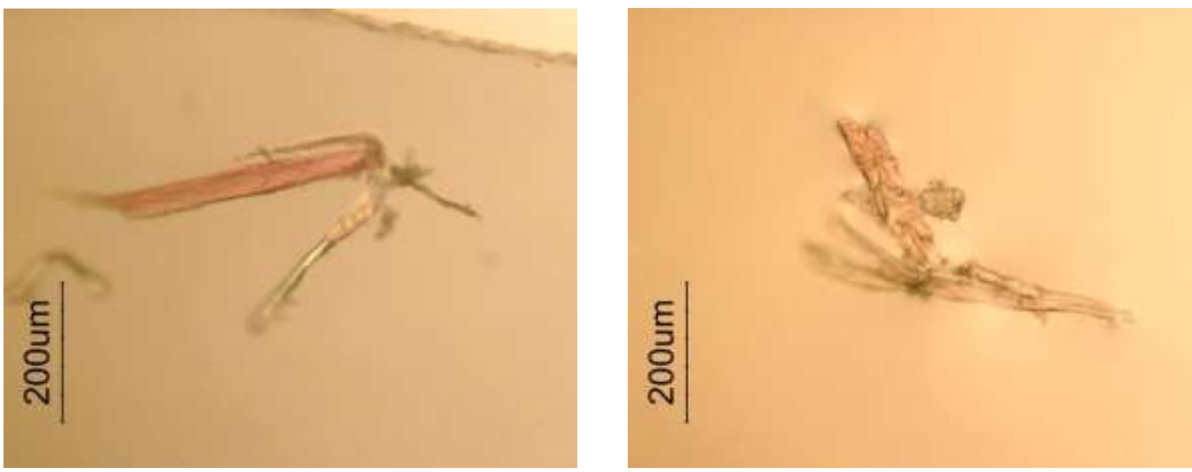


Figure III-4.1. Results of the micro-test Phloroglucinol: Lignin Stain.
On the left: fibres from the fly-leaves. *On the right:* fibres from the guards.

References:

Florian, M.L.E., Kronkright, D.P.; Norton, R. E. *The Conservation of Artifacts made from plant materials*. Los Angeles: Getty Publications, 1990.

A4.1 – Experimental set-up

FORS

FORS measurements in the 350-2200 nm range were performed with a portable device constituted of two Zeiss spectroanalysers equipped with optical fibre bundles: the models MCS601 and the MCS611 NIR 2.2 WR operating in the 200-1000 nm and 900-2200 nm ranges, respectively. It makes possible to obtain reflectance spectra from UV to NIR with an acquisition step of approximately 0.8 nm/pixel for the model MCS 601 UV-Vis (1024 silicon photodiode array detector) and 6 nm/pixel for the model MCS 611 NIR 2.2 WR (256 InGaAs photodiode array detector). The spectroanalysers are mounted on a single chassis together with the light source, a 20W halogen tungsten lamp with colour temperature of about 3000K and emission range from 320 to 2500 nm (model CLH600). Calibration of the spectroanalysers was performed by means of a 99% Spectralon® diffuse reflectance standard. It was used an 8°/8° geometry of measurement. With this geometry the illumination was sent almost perpendicularly to the surface (8°) and the back scattered radiation was collected at the same direction of the illumination, so as to reduce the area effectively measured on the surface to a very small spot of about 1 mm diameter.

μ-EDXRF

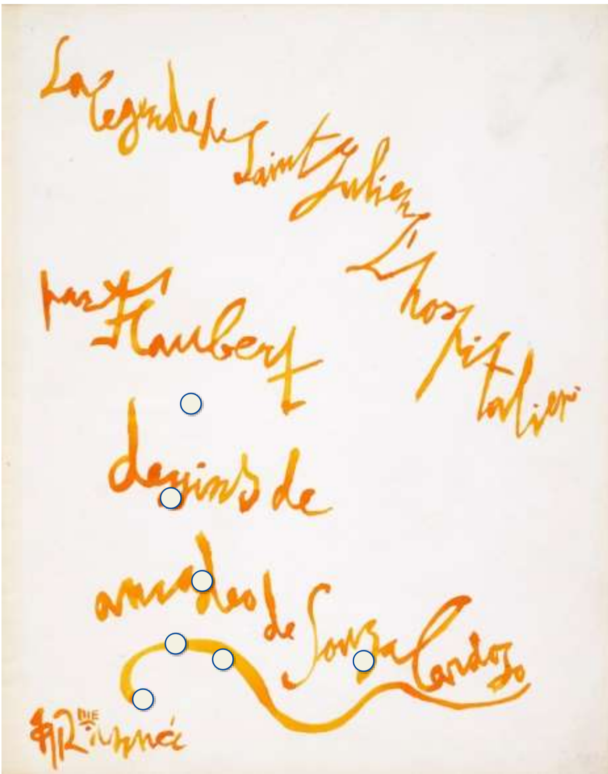
X-Ray fluorescence spectra were recorded using an ArtTAX spectrometer of Intax GmbH, with a molybdenum (Mo) anode. Xflash detector is refrigerated by the Peltier effect (Si drift) with a resolution smaller than 170 eV. The experimental parameters used were: 40 KV of voltage, 300 μA of intensity and 100 s of acquisition time.

μ-Raman

Analyses with Raman microscopy were performed using a Labram 300 Jobin Yvon spectrometer equipped with a He-Ne laser of 17 mW power operating at 632.8 nm. The laser beam was focused either with a 100 x and 150 x Olympus objectives lens. The laser power at the surface of the samples was varied with the aid of a set of neutral density filters (optical densities 0.3; 0.6; 1 and 2).

A4.2* – Areas of analysis in *La Légende de Saint Julien l'Hospitalier

- **Main pages**



p. 2

p. 5

p. 21

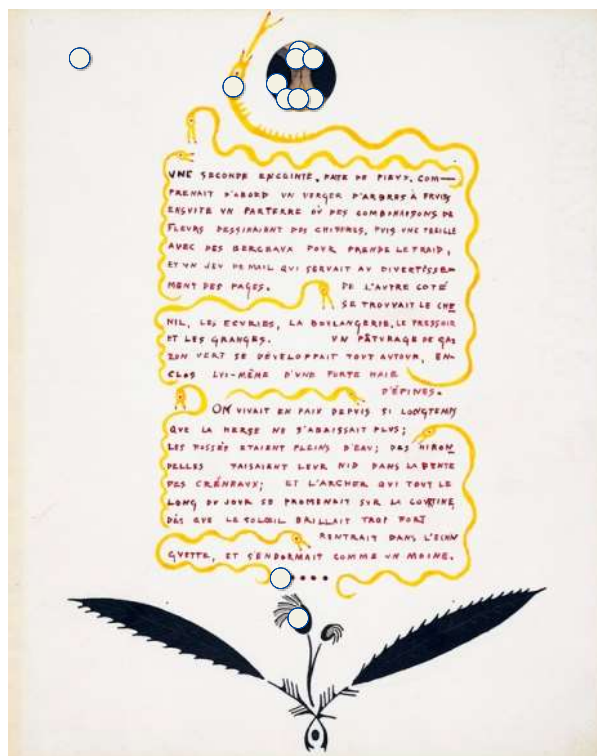
p. 24

Figure IV-2.1. Areas where FORS (◯) analyses were performed in *La Légende*: p. 2, 5, 21 and 24, MG-MC.

p. 27

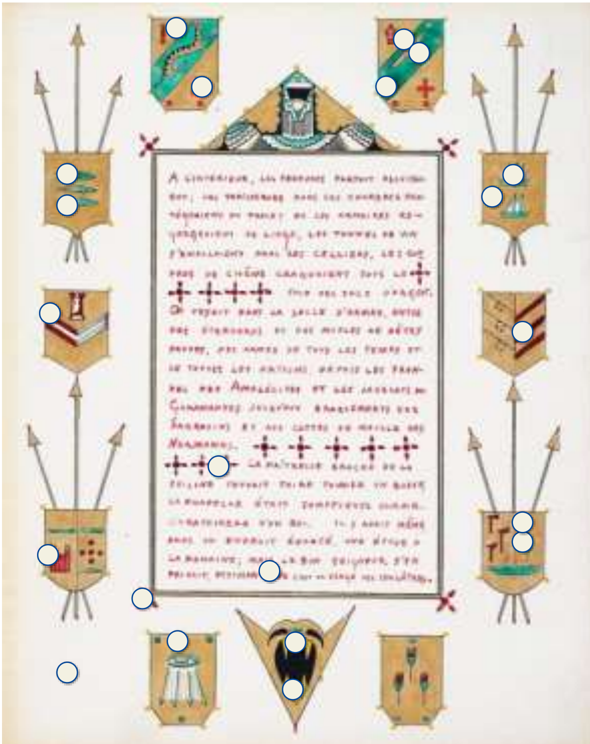
p. 42

p. 48



p. 52

Figure IV-2.2. Areas where FORS (○) and μ-EDXRF (✹) analyses were performed in *La Légende*: p. 27, 42, 48 and 52, MG-MC.



p. 53

p. 60

p. 62

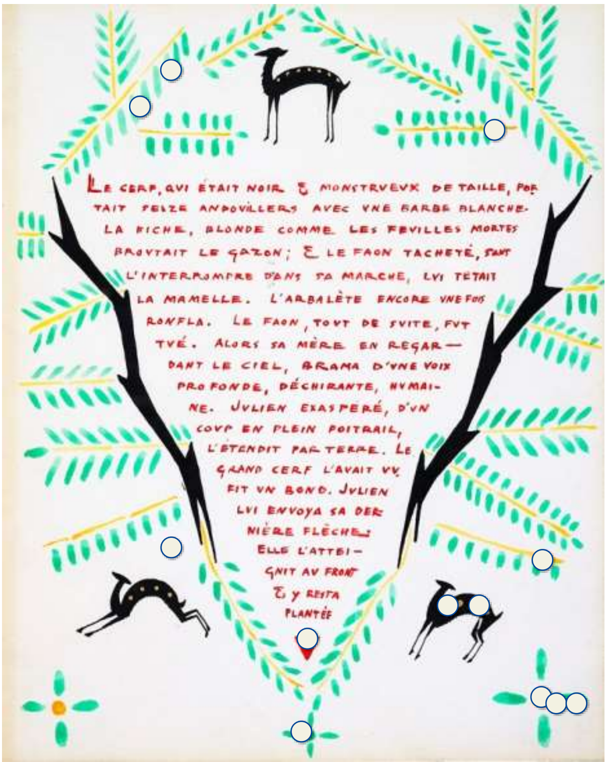
p. 65

Figure IV-2.3. Areas where FORS (○), μ-EDXRF (✹) and μ-EDXRF + μ-Raman (✪) analyses were performed in *La Légende*: p. 53, 60, 62 and 65, MG-MC.

p.66 p.74

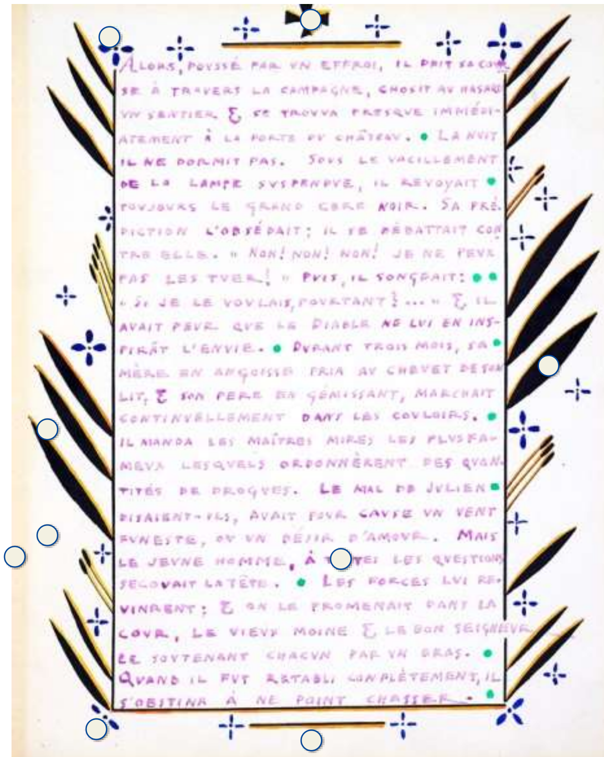
p.80 p.82

Figure IV-2.4. Areas where FORS (○), μ-EDXRF (✹), μ-Raman (◎) and μ-EDXRF + μ-Raman (✪) analyses were performed in *La Légende*: p. 66, 74, 80 and 82, MG-MC.



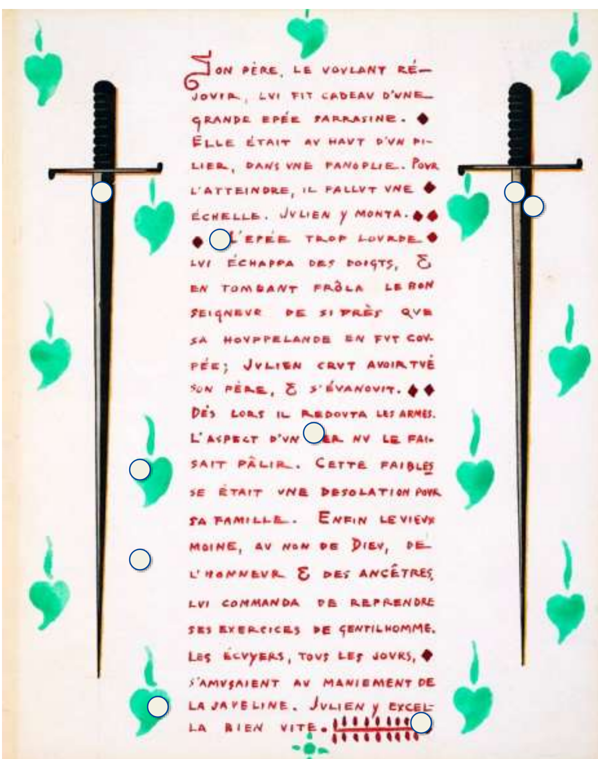
LE CERF, QVI ÉTAIT NOIR & MONSTRVEVX DE TAILLE, POR-
TAIT SEIZE ANDOVILLERS AVEC VNE BARBE BLANCHE.
LA BICHE, BLONDE COMME LES FEVILLES MORTES
BROVTAIT LE GAZON; & LE FAON TACHETÉ, SANS
L'INTERROMPRE DANS SA MARCHE, LVI TETAIT
LA MAMELLE. L'ARBALÈTE ENCORE VNE FOIS
RONFLA. LE FAON, TOVT DE SVITE, FVT
TVÉ. ALORS SA MÈRE EN REGAR-
DANT LE CIEL, BRAMA D'VNE VOIX
PROFONDE, DÉCHIRANTE, HVMAI-
NE. JVLIEN EXASPÉRÉ, D'VN
COVP EN PLEIN POITRAIL,
L'ÉTENDIT PAR TERRE. LE
GRAND CERF L'AVAIT VV,
FIT VN BOND. JVLIEN
LVI ENVOYA SA DER-
NIÈRE FLÈCHE.
ELLE L'ATTEI-
GNIT AV FRONT
& Y RESTA
PLANTÉE

p. 84



ALORS, POVSSÉ PAR VN EFFROI, IL PRIT SA COVR-
SE À TRAVERS LA CAMPAGNE, CHOISIT AV HASARD
VN SENTIER & SE TROVVA PRESQVE IMMÉDI-
ATEMENT À LA PORTE DV CHÂTEAV. • LA NVIT
IL NE DORMIT PAS. SOVS LE VACILLEMENT
DE LA LAMPE SVSPENDVE, IL REVOYAIT •
TOVJOVRS LE GRAND CERF NOIR. SA PRÉ-
DICTION L'OBSÉDAIT; IL SE DÉBATTAIT CON-
TRE ELLE. « NON! NON! NON! JE NE PEVX
PAS LES TVER! » PVIS, IL SONGEAIT: ••
« SI JE LE VOVLAIS, POVRTANT! ... » & IL
AVAIT PEVR QVE LE DIABLE NE LVI EN INS-
PIRÂT L'ENVIE. • DVRANT TROIS MOIS, SA •
MÈRE EN ANGOISSE PRIA AV CHEVET DE SON
LIT, & SON PÈRE EN GÉMISSANT, MARCHAIT
CONTINVELLEMENT DANS LES COVLOIRS. •
IL MANDA LES MAÎTRES MIRES LES PLVS FA-
MEVX LESQVELS ORDONNÈRENT DES QVAN-
TITÉS DE DROGVES. LE MAL DE JVLIEN •
DISAIENT-ILS, AVAIT POVR CAVSE VN VENT
FVNESTE, OV VN DÉSIR D'AMOVR. MAIS
LE JEVNE HOMME, À TOVTES LES QVESTIONS
SECOVAIT LA TÊTE. • LES FORCES LVI RE-
VINRENT; & ON LE PROMENAIT DANS LA
COVR, LE VIEVX MOINE & LE BON SEIGNEVR
LE SOVTENANT CHACVN PAR VN BRAS. •
QVAND IL FVT RÉTABLI COMPLÈTEMENT, IL
S'OBSTINA À NE POINT CHASSER. •

p. 87

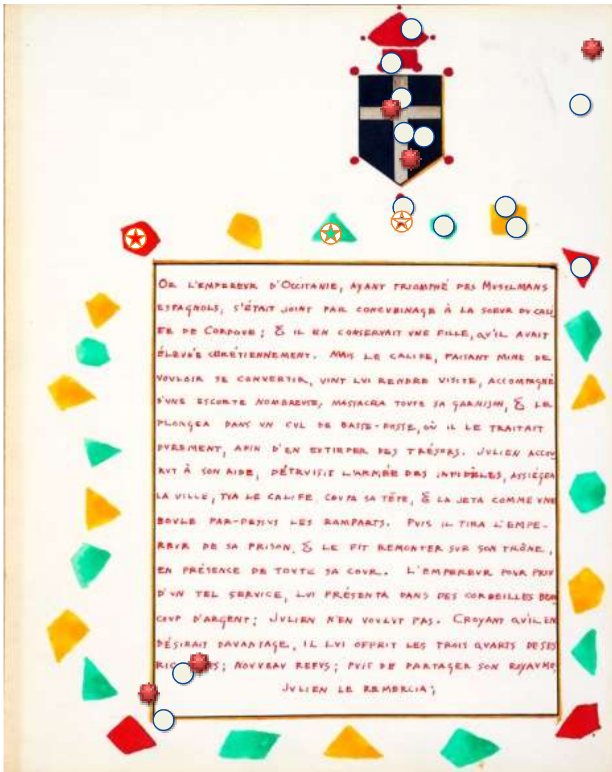


SON PÈRE, LE VOVLANT RÉ-
JOVIR, LVI FIT CADEAV D'VNE
GRANDE ÉPÉE SARRASINE. ◆
ELLE ÉTAIT AV HAVT D'VN PI-
LIER, DANS VNE PANOPLIE. POVR
L'ATTEINDRE, IL FALLVT VNE ◆
ÉCHELLE. JVLIEN Y MONTA. ◆◆
◆ L'ÉPÉE TROP LOVRDE ◆
LVI ÉCHAPPA DES DOIGTS, &
EN TOMBANT FRÔLA LE BON
SEIGNEVR DE SI PRÈS QVE
SA HOVPPELANDE EN FVT COV-
PÉE; JVLIEN CRVT AVOIR TVÉ
SON PÈRE, & S'ÉVANOVIT. ◆◆
DÈS LORS IL REDOVTA LES ARMES.
L'ASPECT D'VN FER NV LE FAI-
SAIT PÂLIR. CETTE FAIBLES
SE ÉTAIT VNE DÉSOLATION POVR
SA FAMILLE. ENFIN LE VIEVX
MOINE, AV NOM DE DIEV, DE
L'HONNEVR & DES ANCÊTRES,
LVI COMMANDA DE REPRENDRE
SES EXERCICES DE GENTILHOMME.
LES ÉCVYERS, TOVS LES JOVRS, ◆
S'AMVSAIENT AV MANIEMENT DE
LA JAVELINE. JVLIEN Y EXCEL-
LA BIEN VITE.

p. 88

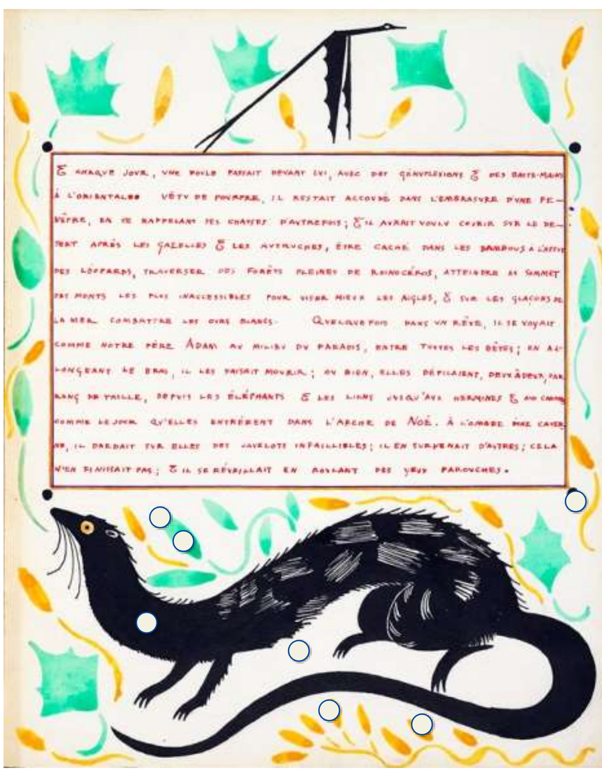
p. 91

Figure IV-2.5. Areas where FORS (○) analyses were performed in *La Légende*: p. 84, 87, 88 and 91, MG-MC.



p. 97

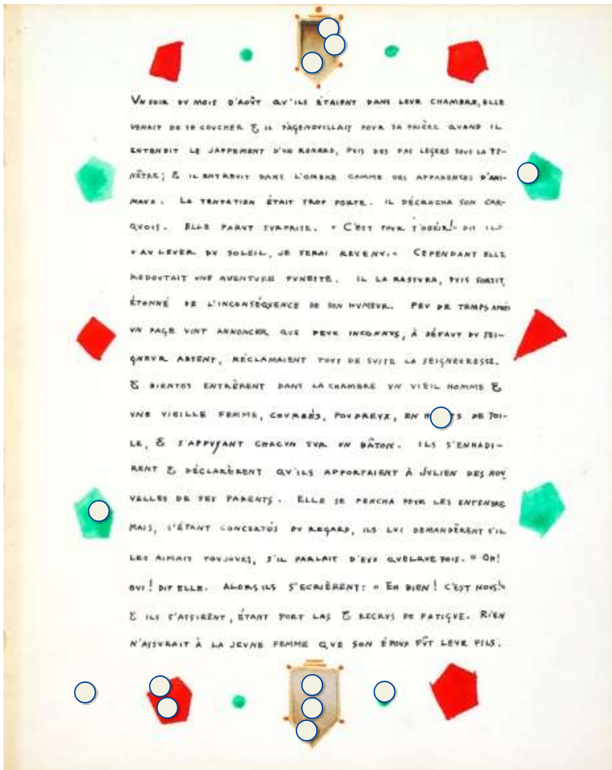
p. 99



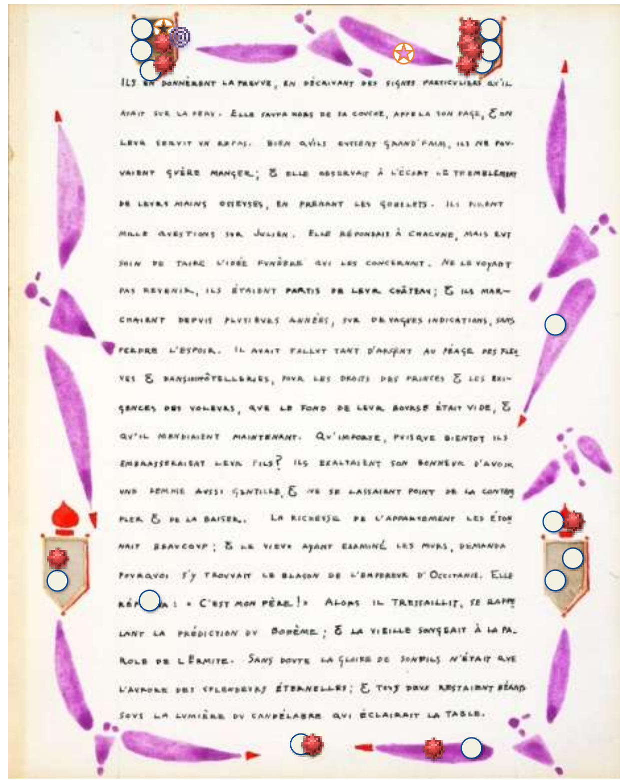
p. 101

p. 103

Figure IV-2.6. Areas where FORS (○), μ-EDXRF (●), μ-EDXRF + μ-Raman (✪) analyses were performed in *La Légende*: p. 97, 99, 101 and 103, MG-MC.



p. 104



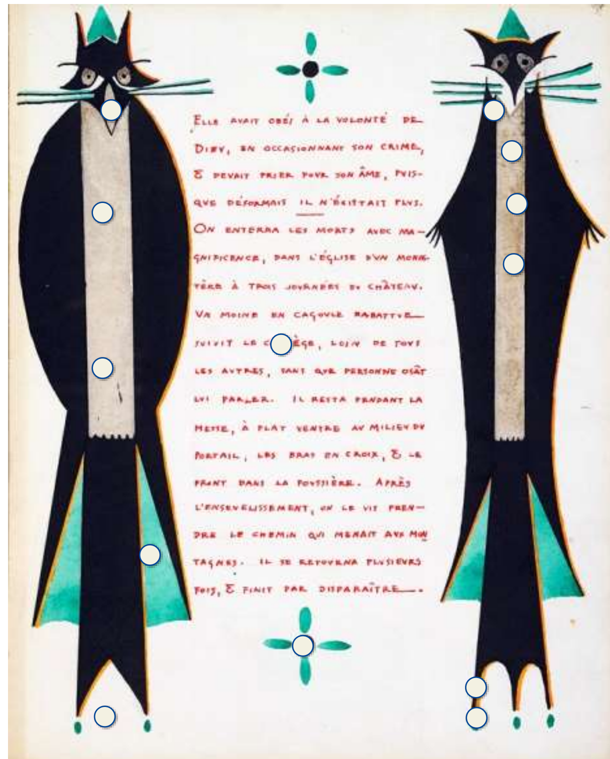
p. 105

p. 108

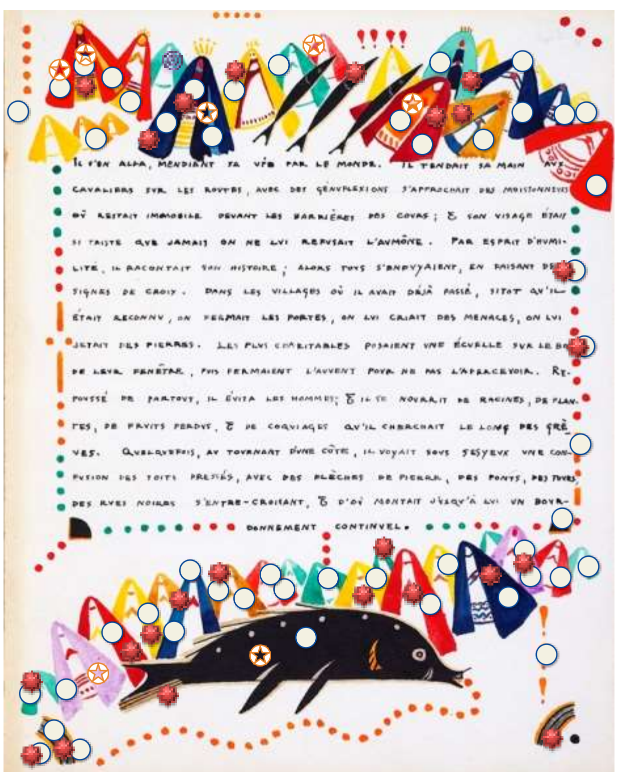
p. 116

Figure IV-2.7. Areas where FORS (◯), μ-EDXRF (✸) and μ-EDXRF + μ-Raman (✪) analyses were performed in *La Légende*: p. 104, 105, 108 and 116, MG-MC.

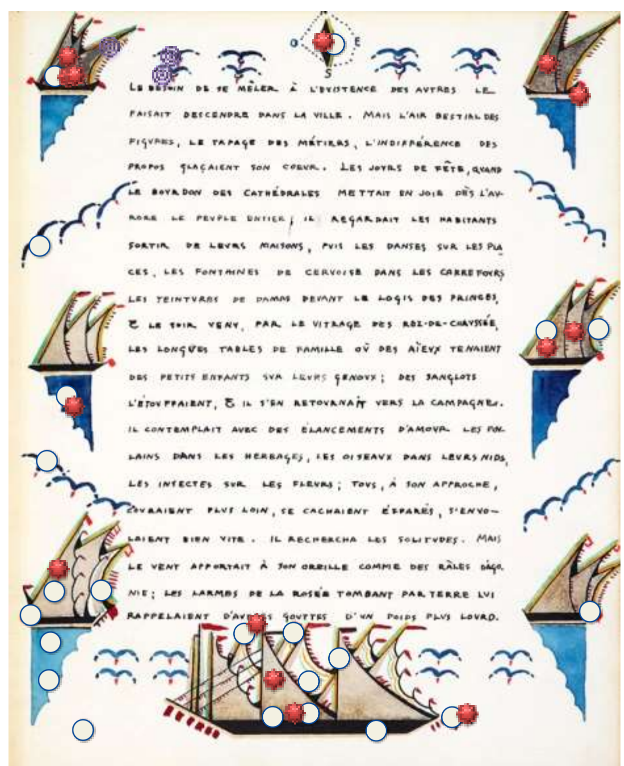
p. 117



p. 119



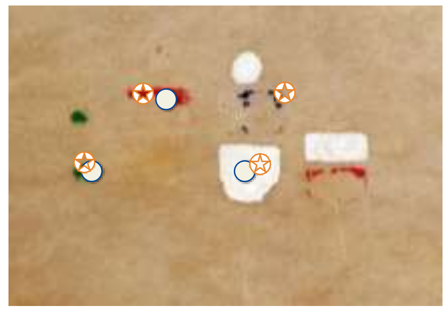
p. 123



p.124

Figure IV-2.8. Areas where FORS (◯), μ-EDXRF (✹), μ-Raman (◎) and μ-EDXRF + μ-Raman (✪) analyses were performed in *La Légende*: p. 117, 119, 123 and 124, MG-MC.

Figure IV-2.9. Areas where FORS (○), μ-EDXRF (✹) and μ-EDXRF + μ-Raman (✪) analyses were performed in *La Légende*: p. 131, 134, 136 and 137, MG-MC.



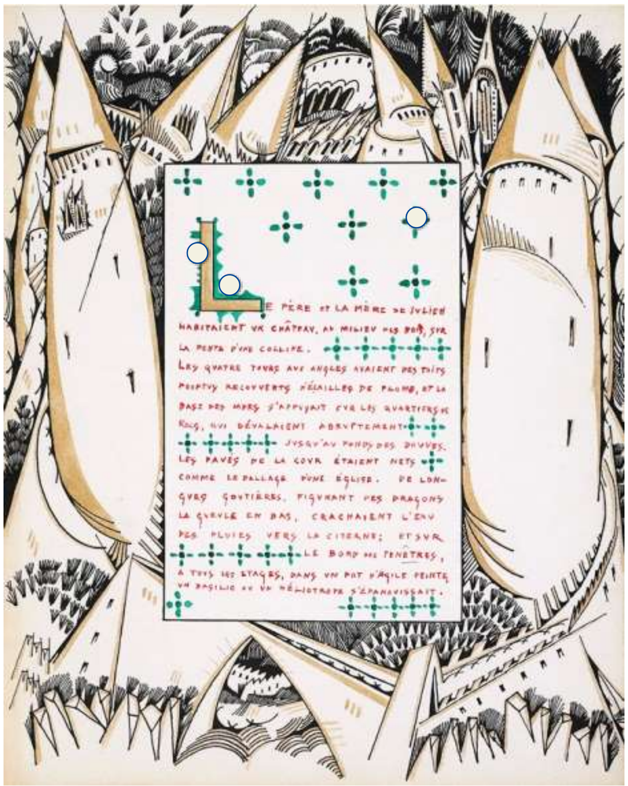
Detail from the cover

p. 139

Cover **Back cover**

Figure IV-2.10. Areas where FORS (○), μ-EDXRF (✹), μ-Raman (◎) and μ-EDXRF + μ-Raman (✪) analyses were performed in *La Légende*: p139, cover and back cover, MG-MC.

- **Extra pages**



p. 51

p. 55

p. 56

p. 57

Figure IV-2.11. Areas where FORS (○) analyses were performed in *La Légende*: p. 51, 55, 56 and 57, MG-MC.

p. 59

p. 63

p. 67

p. 68v

Figure IV-2.12. Areas where FORS (○) analyses were performed in *La Légende*: p. 59, 63, 67 and 68v, MG-MC.

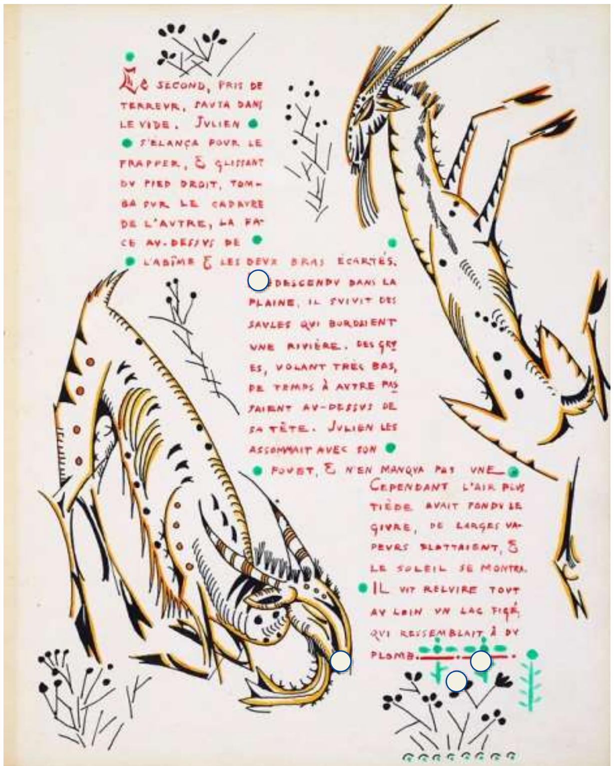
p. 69

p. 70

p. 71

p. 77

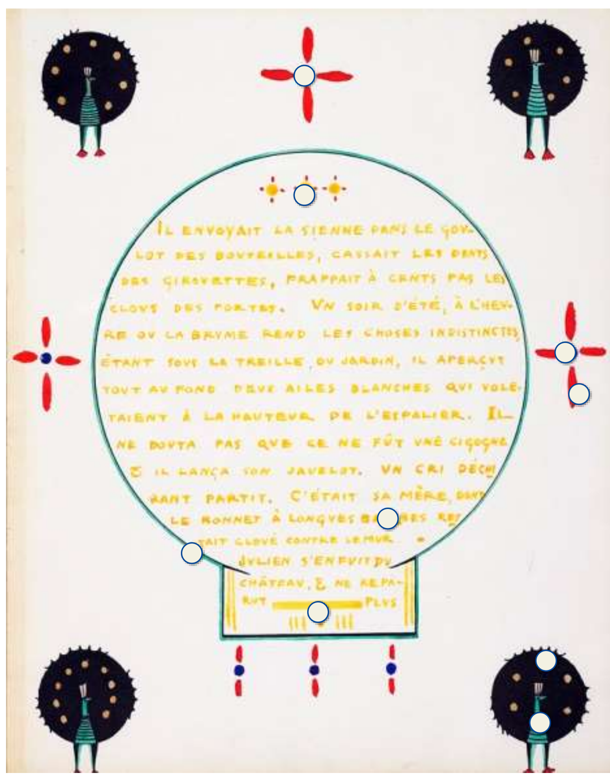
Figure IV-2.13. Areas where FORS (○) analyses were performed in *La Légende*: p. 69, 70, 71 and 77, MG-MC.



p. 78

p. 81

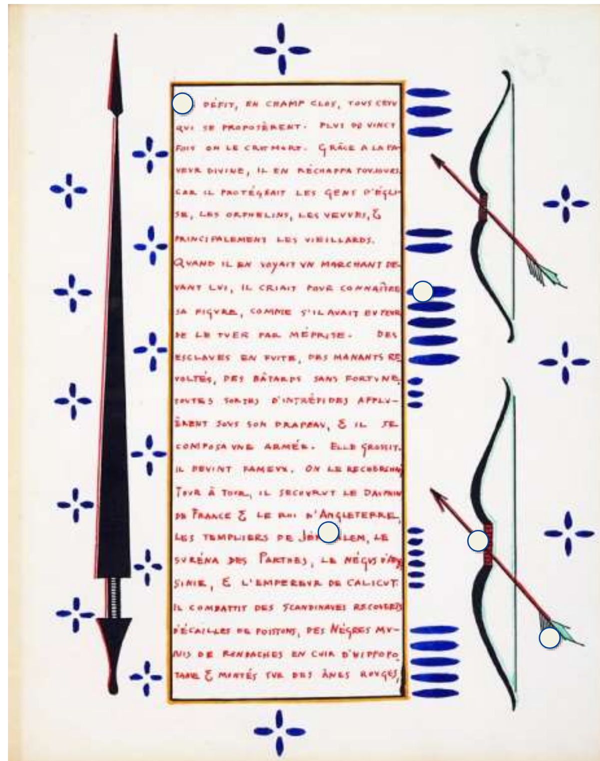
p. 85



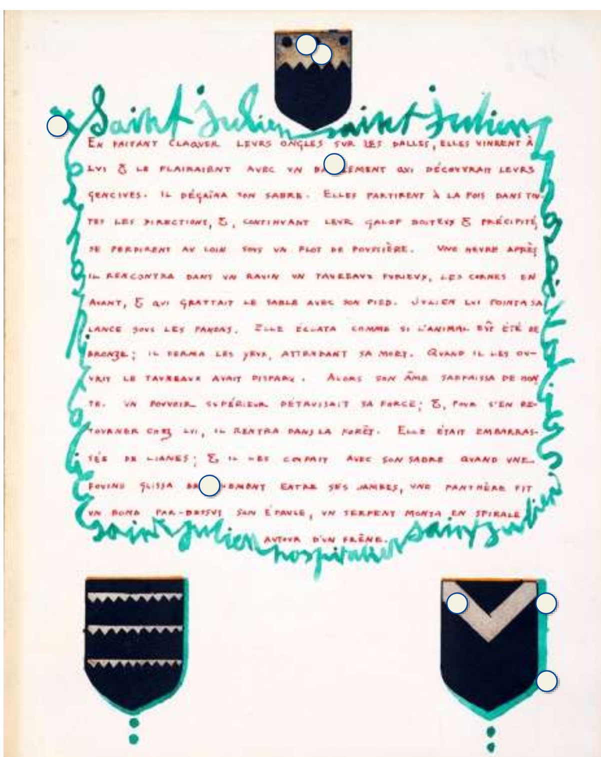
p. 89

Figure IV-2.14. Areas where FORS (◯) analyses were performed in *La Légende*: p. 78, 81, 85 and 89, MG-MC.

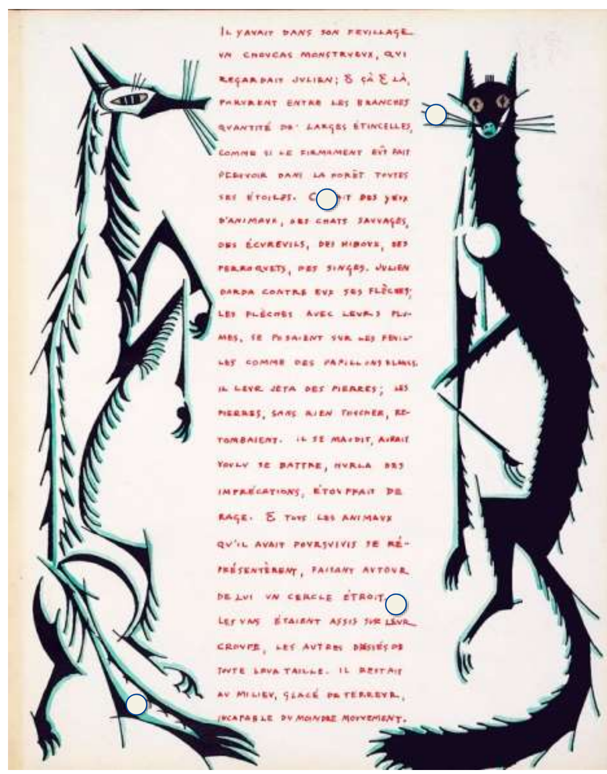
p. 93



p. 94

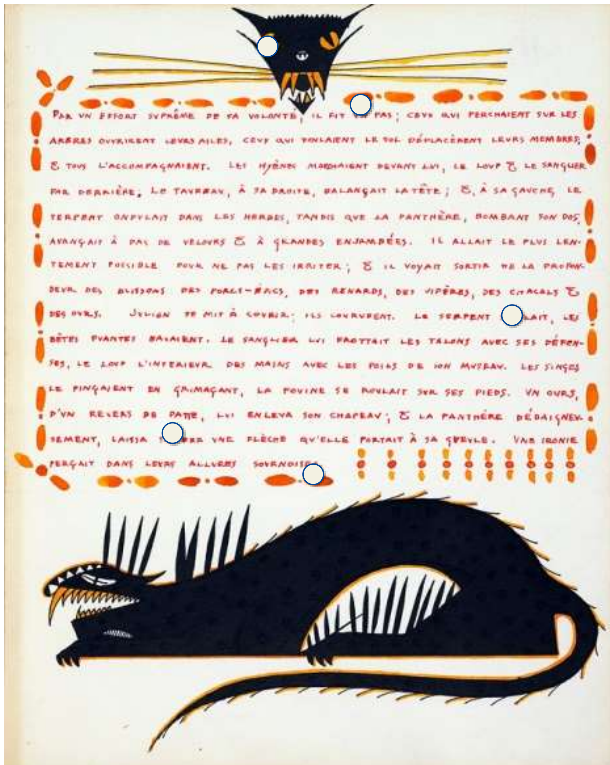


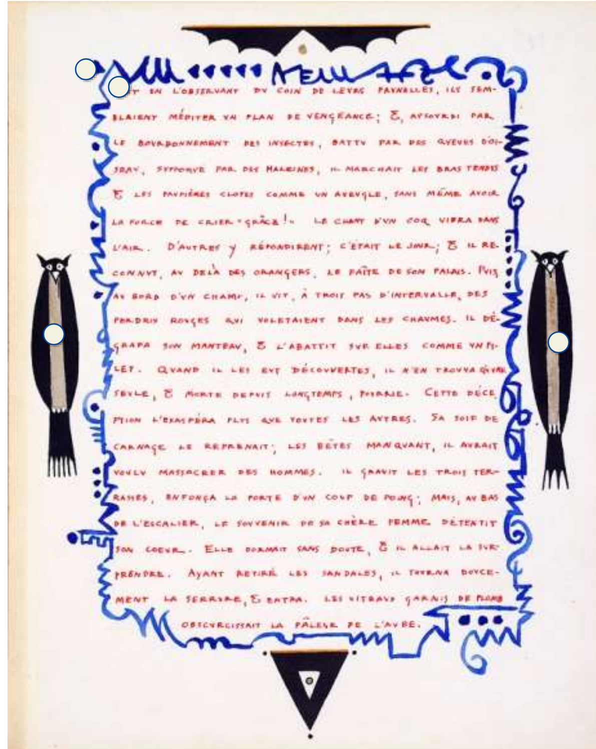
p. 109



p. 111

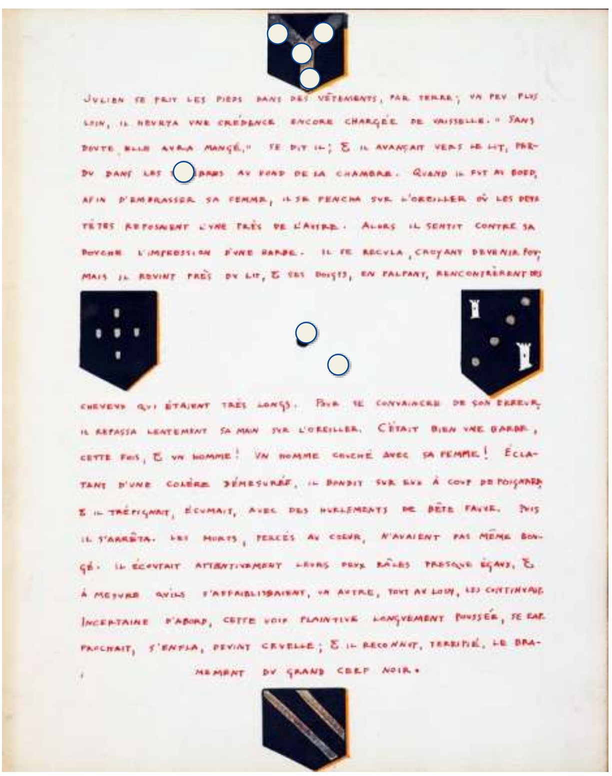
Figure IV-2.15. Areas where FORS (○) analyses were performed in *La Légende*: p. 93, 94, 109 and 111, MG-MC.

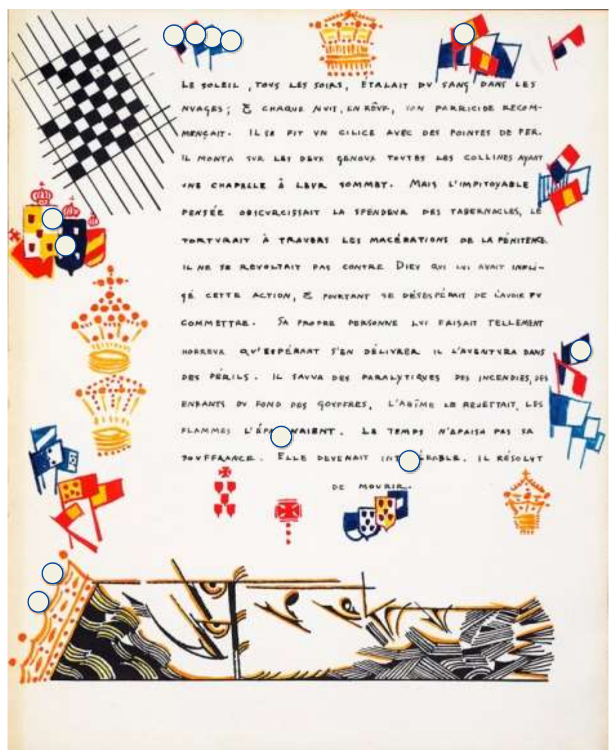




p. 112

p. 113

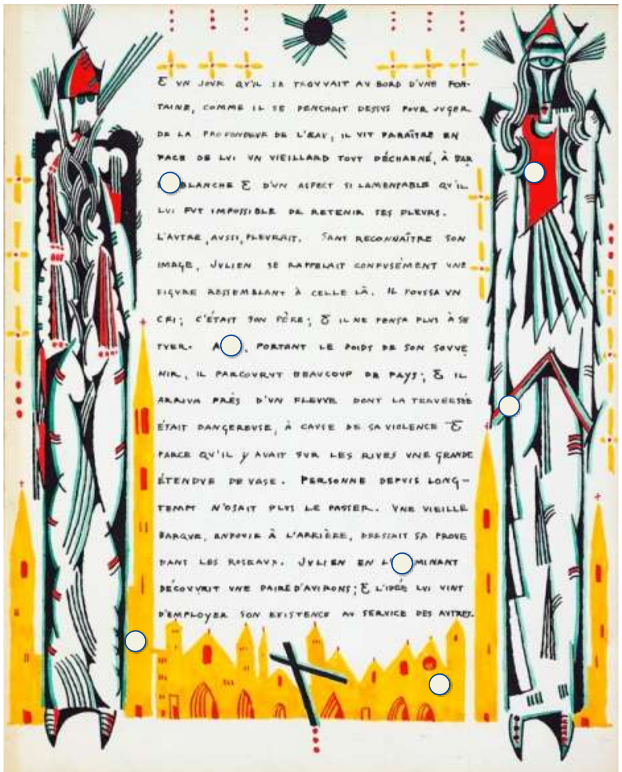




p. 115

p. 125

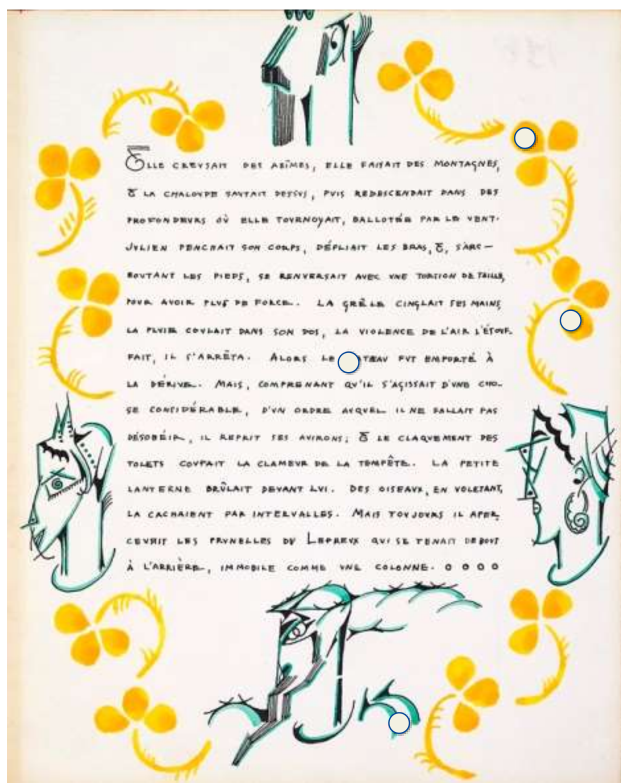
Figure IV-2.16. Areas where FORS (◯) analyses were performed in *La Légende*: p. 112, 113, 115 and 125, MG-MC.



p. 127

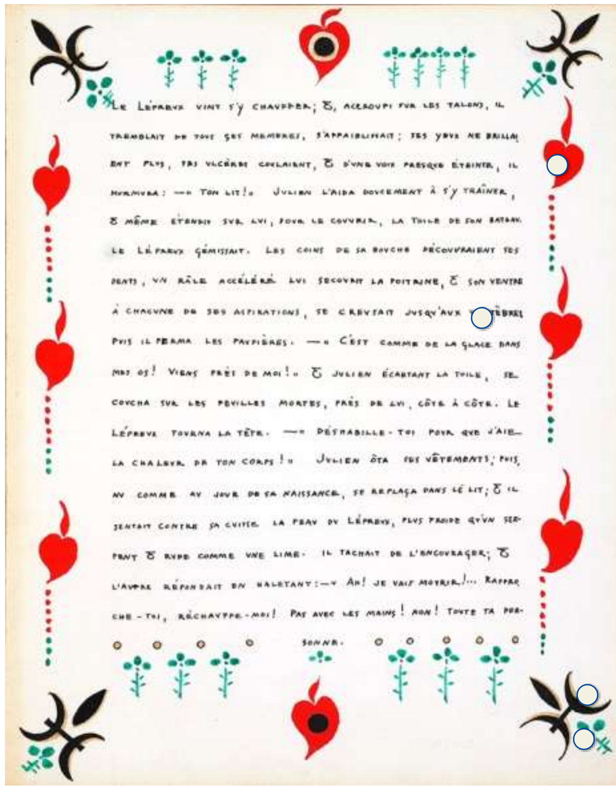
p. 128

p. 129



p. 132

Figure IV-2.17. Areas where FORS (◯) analyses were performed in *La Légende*: p. 127, 128, 129 and 132, MG-MC.



Le Lépreux vint s'y chauffer; & accroupi sur les talons, il tremblait de tous ses membres, s'affaiblissait; ses yeux ne brillaient plus, ses ulcères coulaient, & d'une voix presque éteinte, il murmura: —« Ton lit! » Julien l'aida doucement à s'y traîner, & même étendit sur lui, pour le couvrir, la toile de son bateau. Le Lépreux gémissait. Les coins de sa bouche découvraient ses dents, un râle accéléré lui secouait la poitrine, & son ventre à chacune de ses aspirations, se creusait jusqu'aux [illegible]tèbres puis il ferma les paupières. —« C'est comme de la glace dans mes os! Viens près de moi! » & Julien écartant la toile, se coucha sur les feuilles mortes, près de lui, côte à côte. Le Lépreux tourna la tête. —« Déshabille-toi pour que j'aie la chaleur de ton corps! » Julien ôta ses vêtements; puis, nu comme au jour de sa naissance, se replaça dans le lit; & il sentait contre sa cuisse la peau du Lépreux, plus froide qu'un serpent & rude comme une lime. Il tâchait de l'encourager; & l'autre répondait en haletant: —« Ah! je vais mourir!... Rapproche-toi, réchauffe-moi! Pas avec les mains! non! toute ta personne.

p. 135

Figure IV-2.18. Areas where FORS (○) analyses were performed in *La Légende*: p. 135, MG-MC.

***A4.3* - Representative spectra**

- **Paper and parchment**

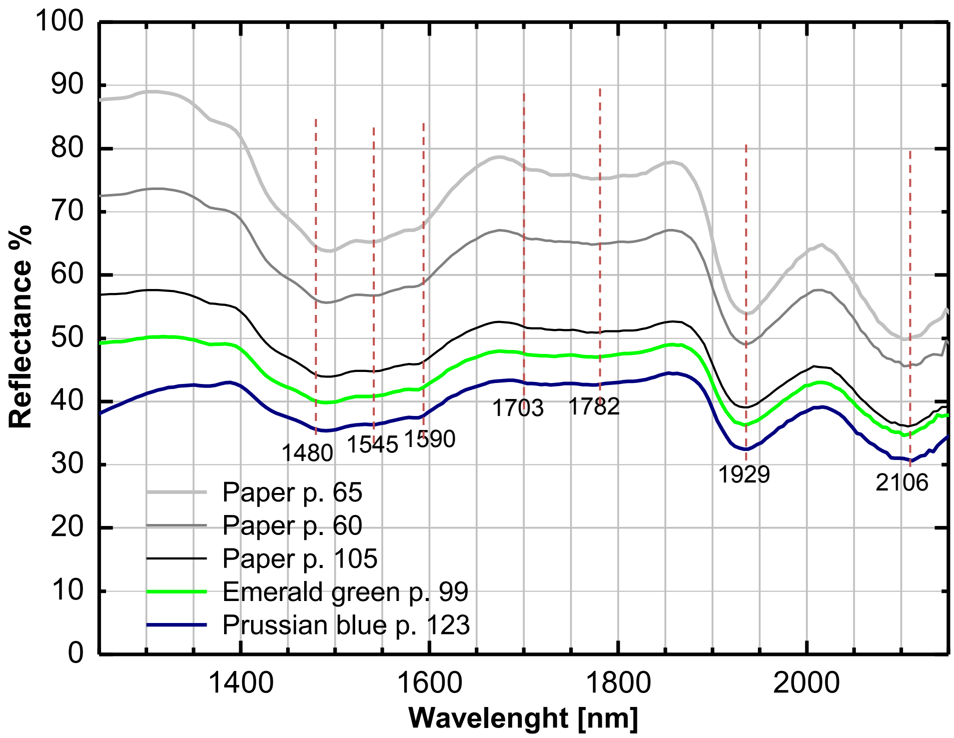
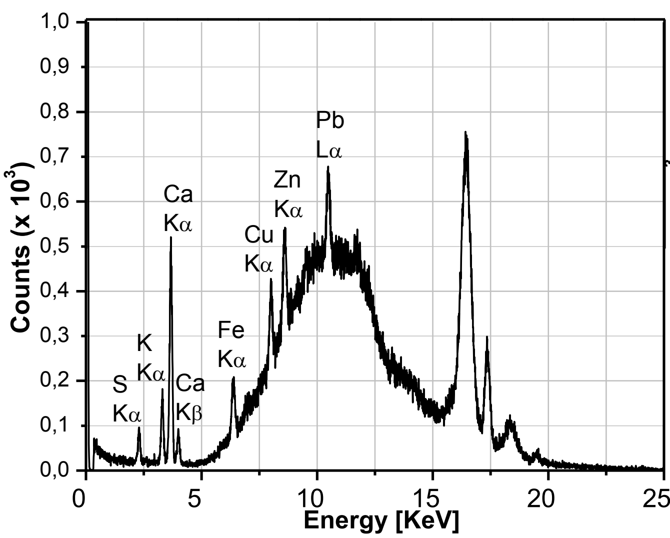


Figure IV-3.1. NIR spectra obtained with FORS: paper, emerald green watercolour on paper and Prussian blue watercolour on paper.



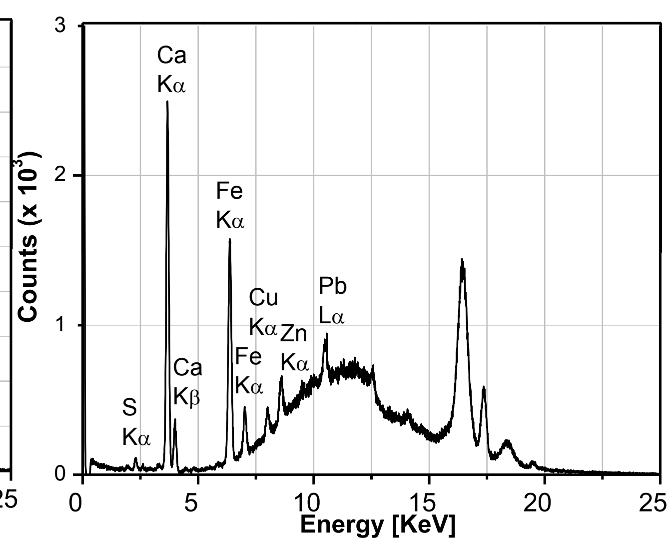


Figure IV-3.2. EDXRF spectra: *On the left:* paper (p. 60). *On the right:* parchment (cover).

- **Cobalt violet**

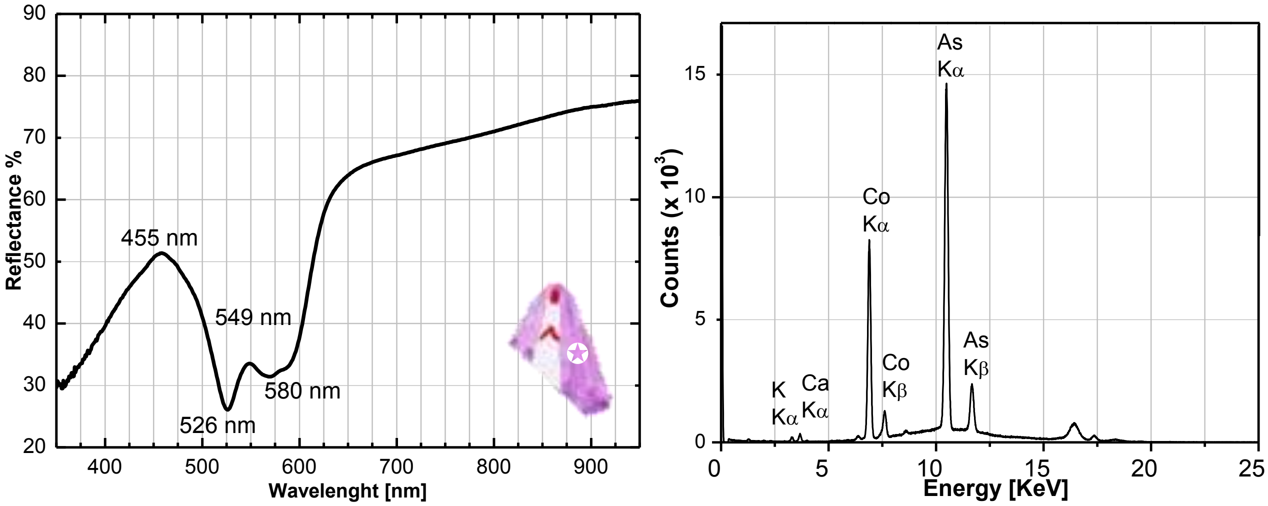


Figure IV-3.3. *On the left:* FORS spectrum of a Cobalt violet coloured area acquired from p. 123 of *La Légende*. *On the left:* μ-EDXRF spectrum from the same area.

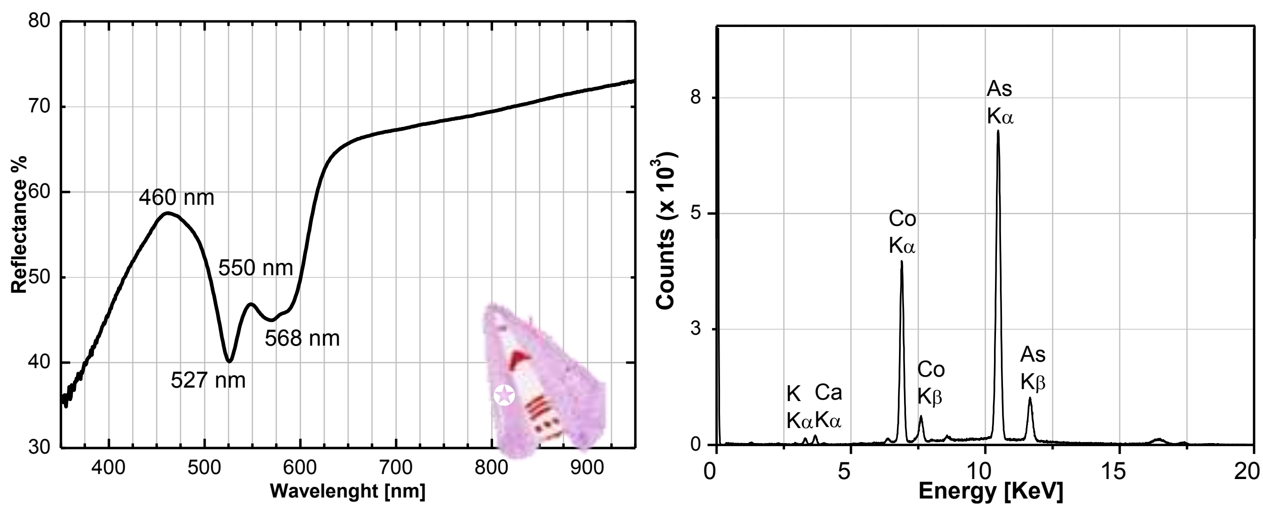


Figure IV-3.4. *On the left:* FORS spectrum of a cobalt violet coloured area acquired from p. 123 of *La Légende*. *On the left:* μ-EDXRF spectrum from the same area.

- **Prussian blue**

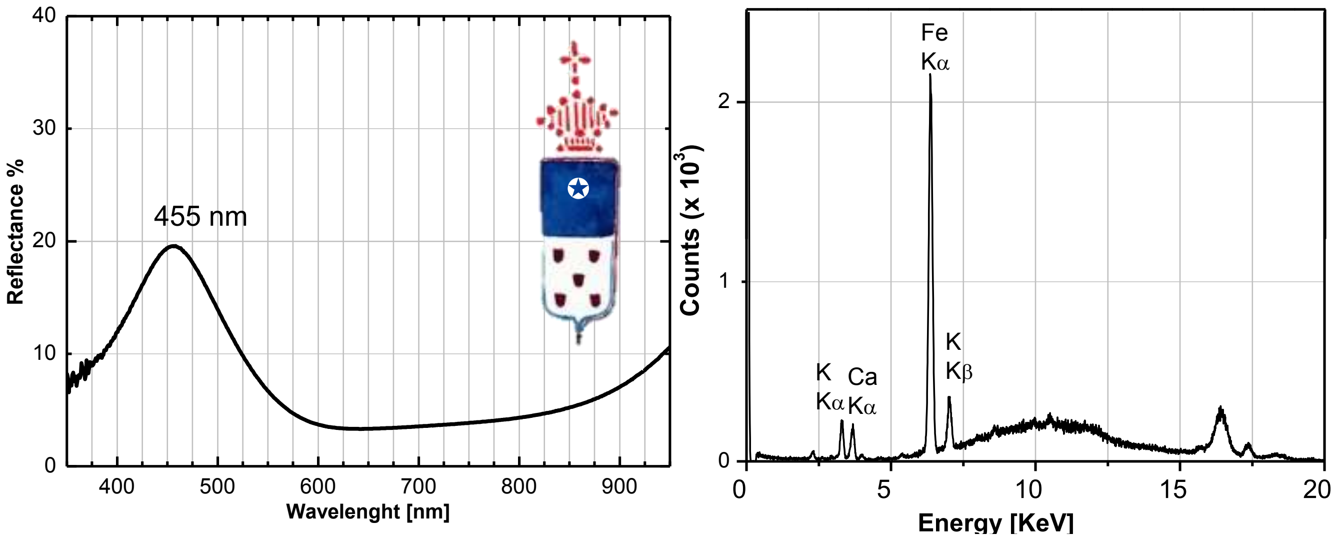


Figure IV-3.5. *On the left:* FORS spectrum of a Prussian Blue coloured area acquired from p. 65 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

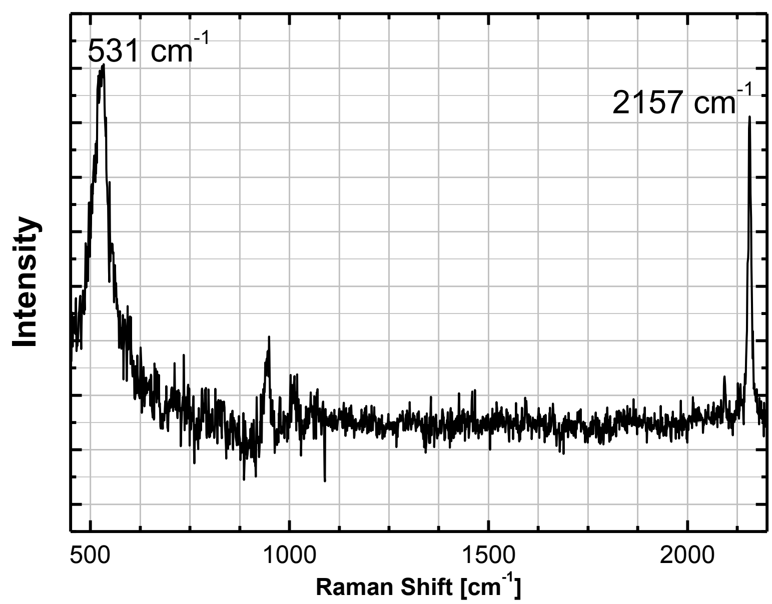


Figure IV-3.6. μ-Raman spectrum of a Prussian Blue coloured area acquired from p. 65 of *La Légende*.

- **Ultramarine blue**

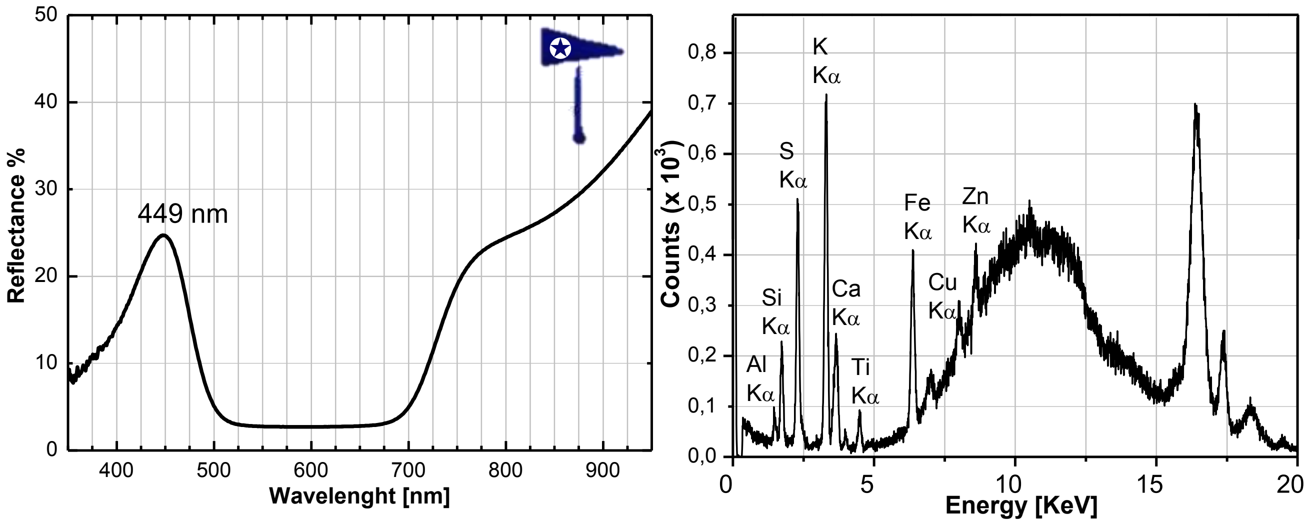


Figure IV-3.7. *On the left:* FORS spectrum of an Ultramarine Blue coloured area acquired from p. 116 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

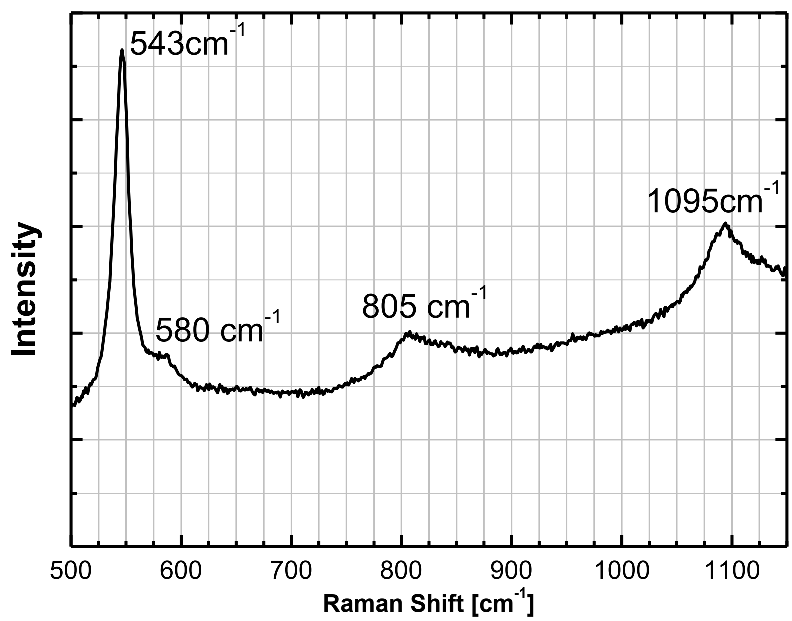
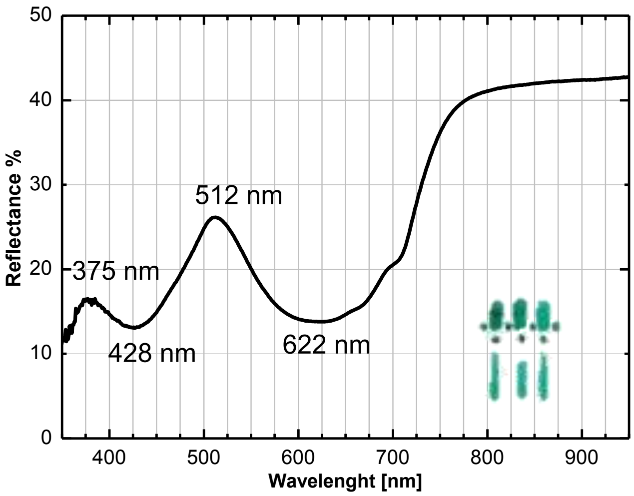


Figure IV-3.8. μ-Raman spectrum of an Ultramarine Blue coloured area acquired from p. 116 of *La Légende*.

♦ **Viridian**



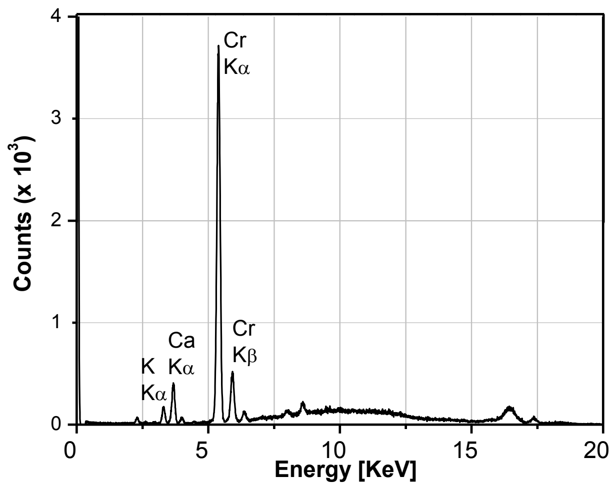


Figure IV-3.9. *On the left:* FORS spectrum of a Viridian coloured area acquired from p. 134 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

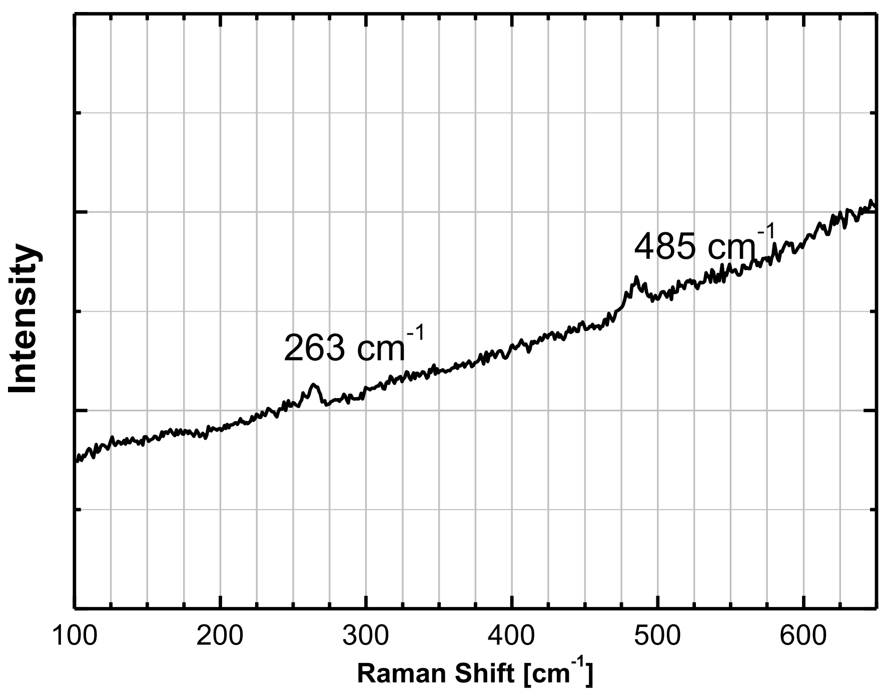


Figure IV.3.10. μ-Raman spectrum of a Viridian coloured area acquired from p. 134 of *La Légende*.

- ♦ **Emerald green**

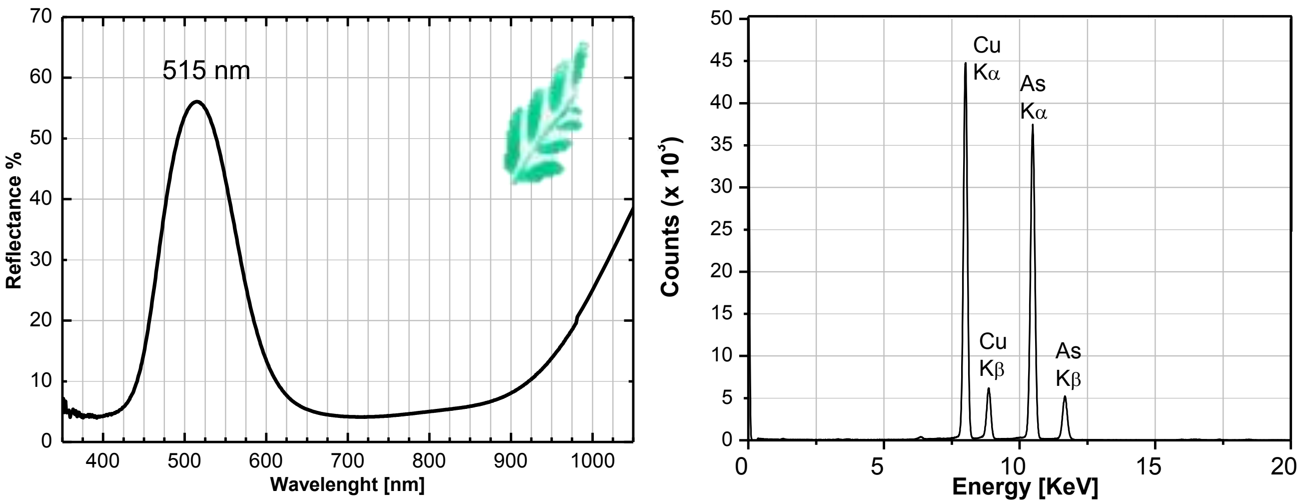


Figure IV-3.11. *On the left:* FORS spectrum of an Emerald Green coloured area acquired from p. 80 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

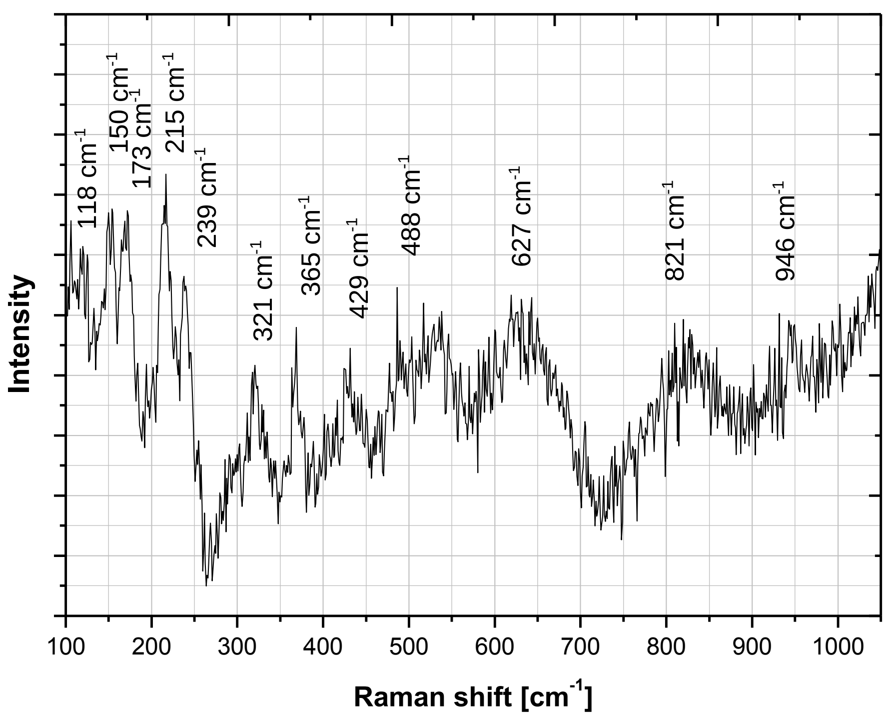


Figure IV-3.12. μ-Raman spectrum of an Emerald Green coloured area acquired from p. 80 of *La Légende*.

♦ **Cadmium yellow**

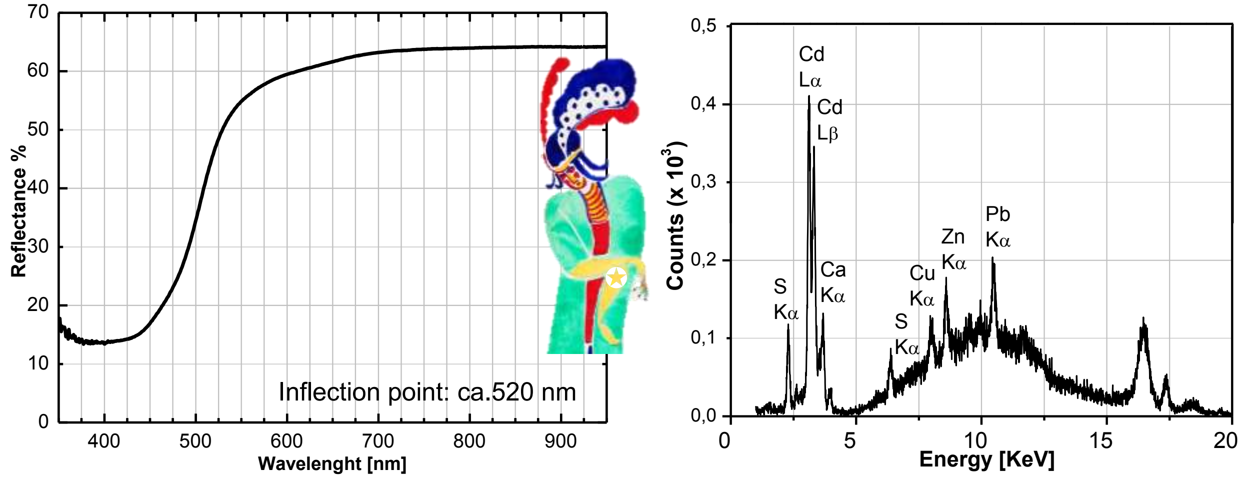


Figure IV-3.13. *On the left:* FORS spectrum of Cadmium Yellow coloured area acquired from p. 99 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

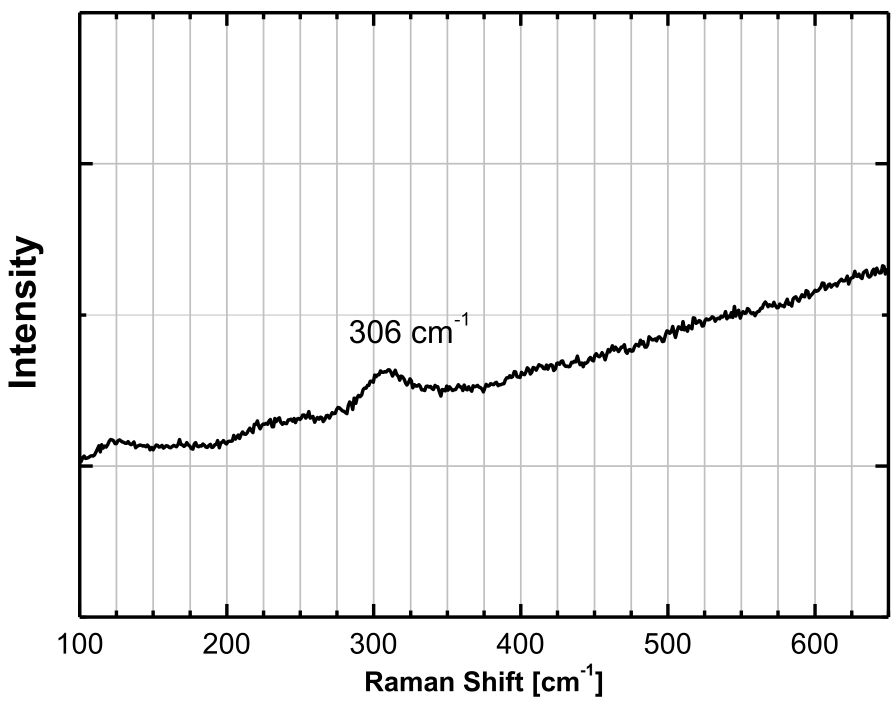


Figure IV-3.14. μ-Raman spectrum of Cadmium Yellow coloured area acquired from p. 99 of *La Légende*.

- **Cadmium orange**

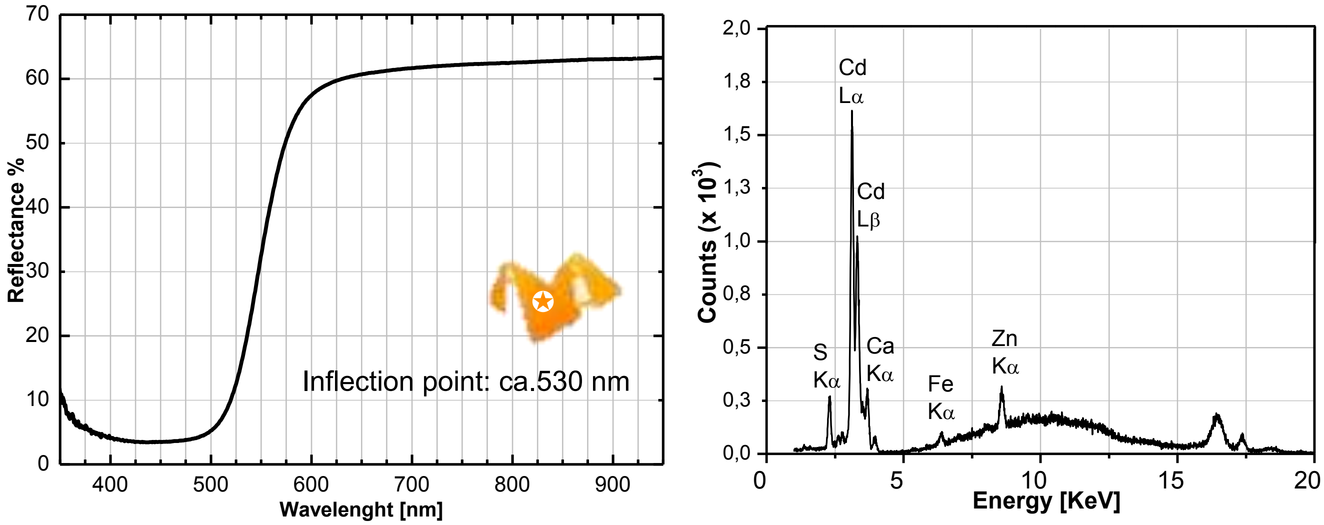


Figure IV-3.15. *On the left:* FORS spectrum of Cadmium Orange coloured area acquired from p. 123 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

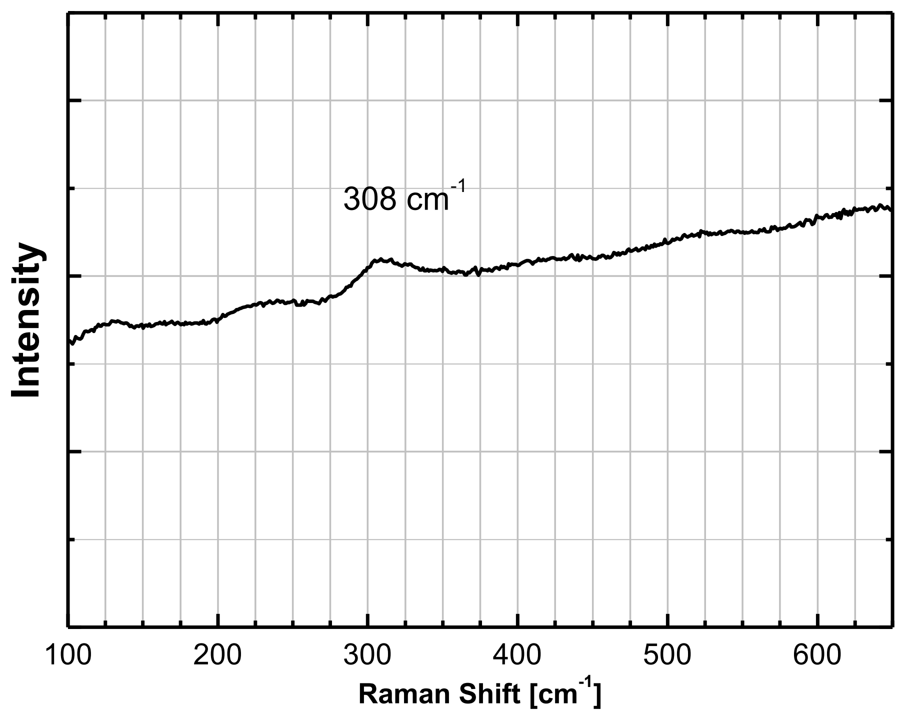


Figure IV-3.16. μ-Raman spectrum of Cadmium Orange coloured area acquired from p. 123 of *La Légende*.

- ♦ **Vermilion**

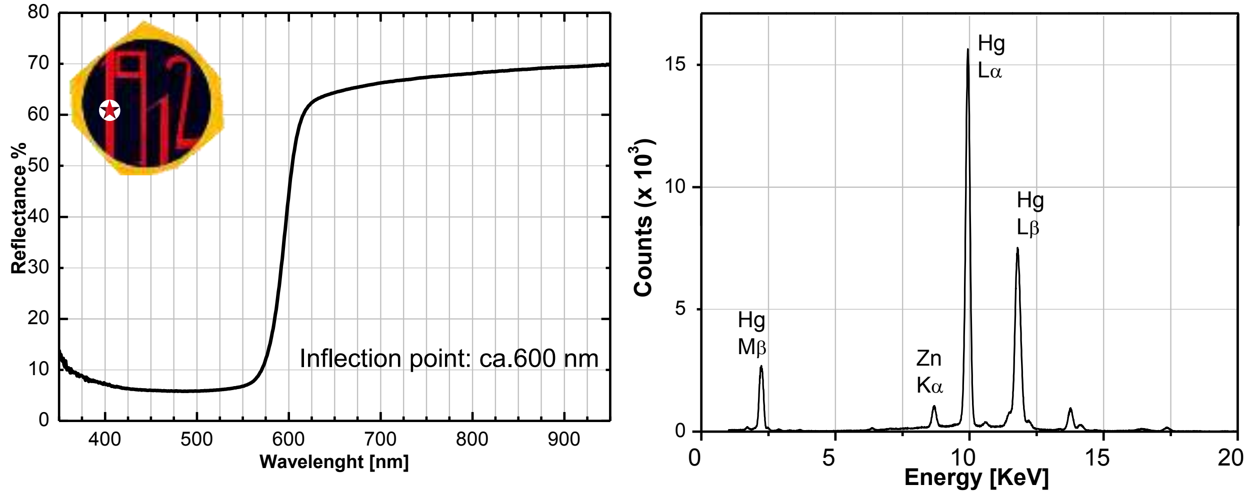


Figure IV-3.17. *On the left:* FORS spectrum of a Vermilion coloured area acquired from p. 139 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

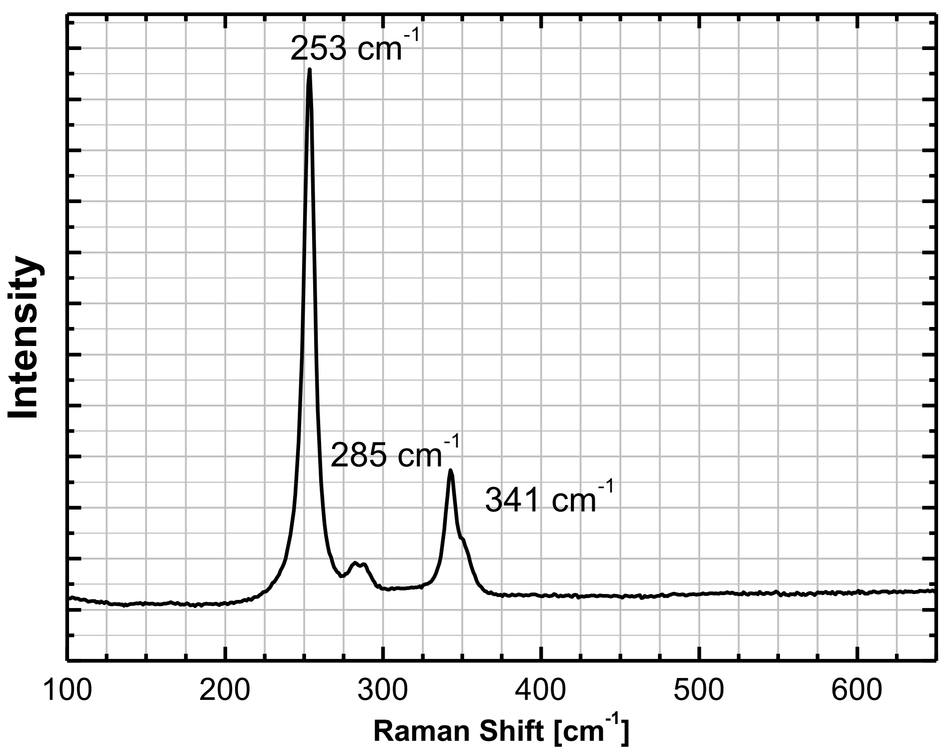


Figure IV-3.18. μ-Raman spectrum of a Vermilion coloured area acquired from p. 139 of *La Légende*.

- **Carmine**

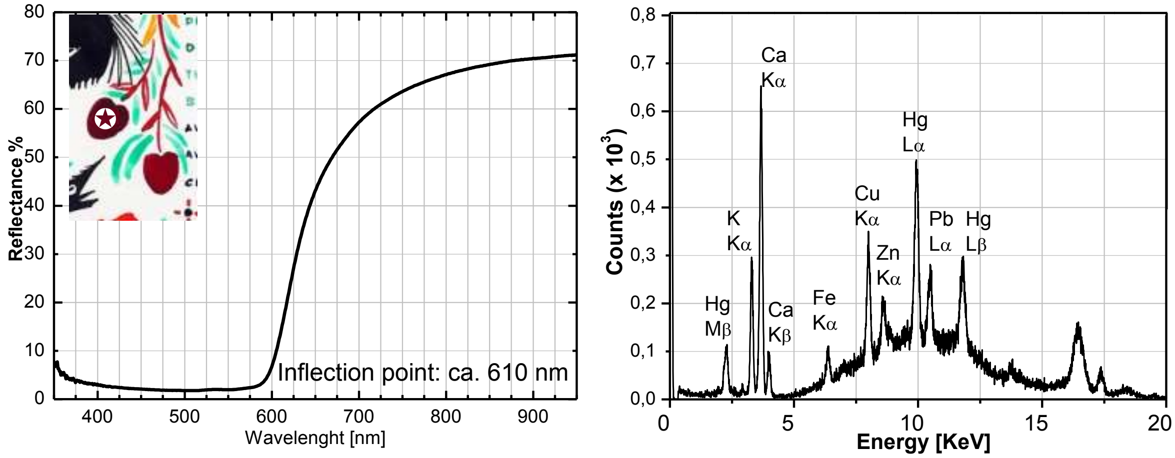


Figure IV-3.19. *On the left:* FORS spectrum of a Carmine coloured area acquired from p. 80 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

- **Carbon black**

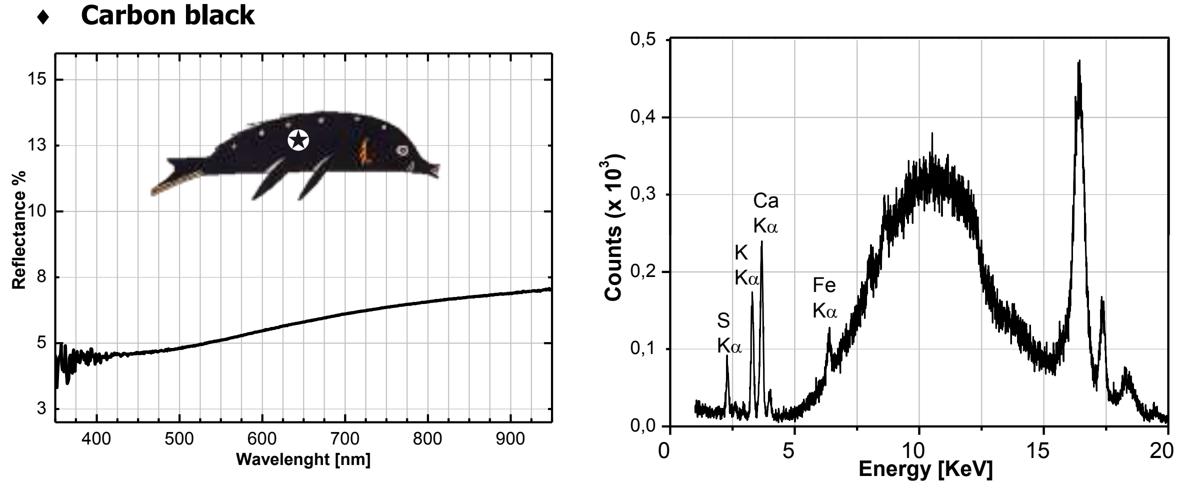


Figure IV-3.20. *On the left:* FORS spectrum of a Carbon black coloured area acquired from p. 80 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

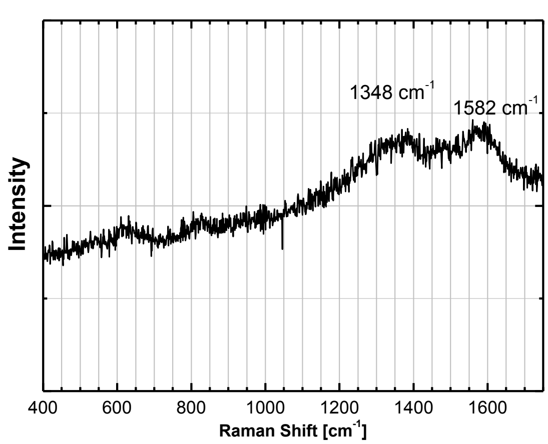


Figure IV-3.21. μ-Raman spectrum of a Carbon black coloured area acquired from p. 80 of *La Légende*.

- **Gold**

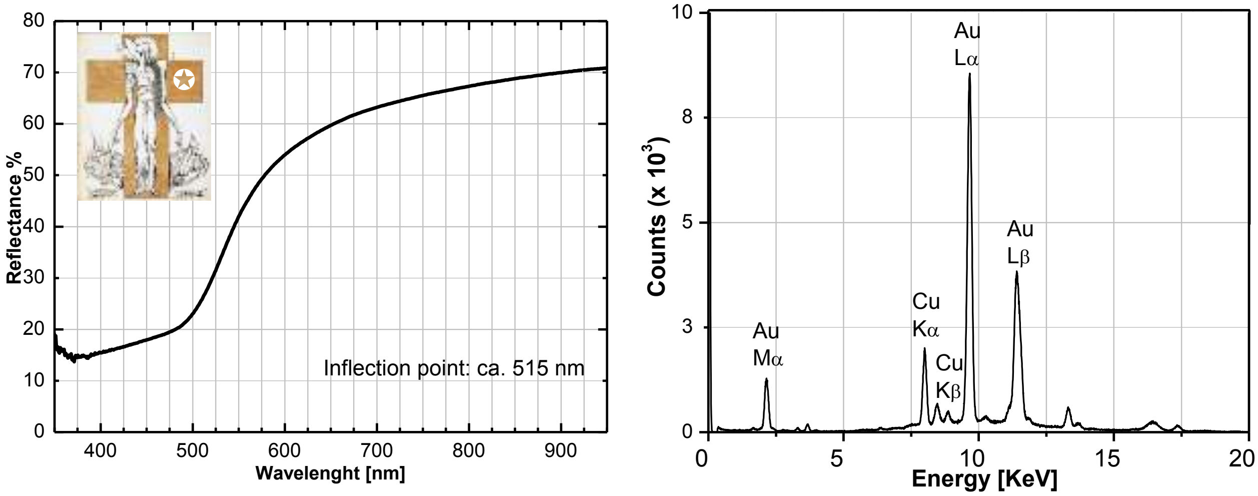


Figure IV.3.22. *On the left:* FORS spectrum of Gold coloured area acquired from p. 42 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

- **Cobalt green**

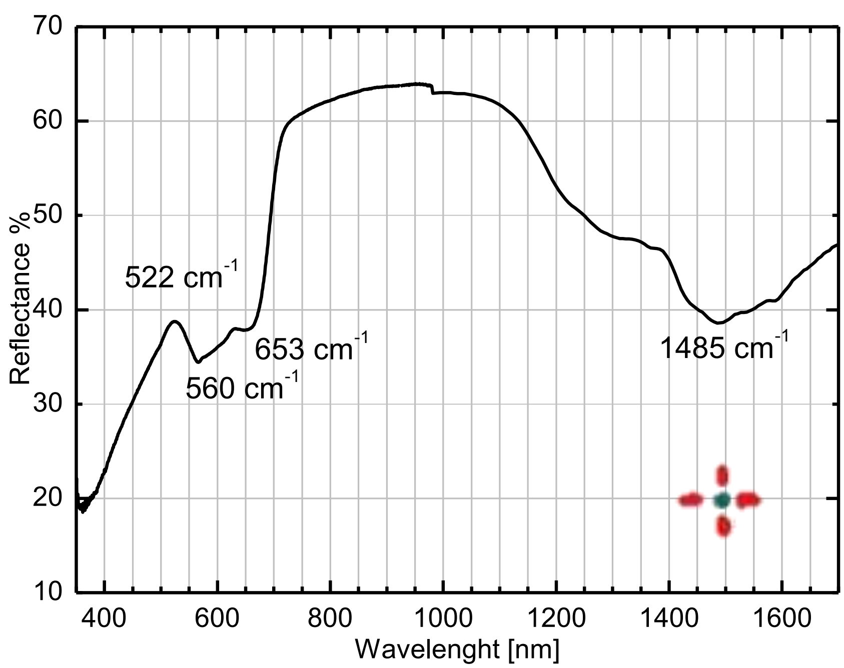
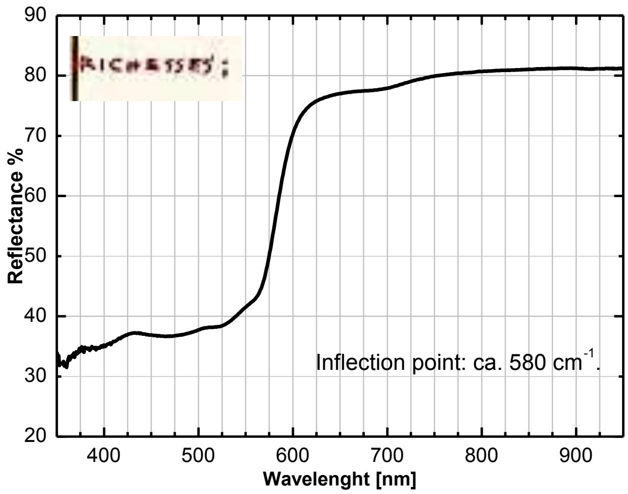


Figure IV-3.23. FORS spectrum of Cobalt green coloured area acquired from p. 74.

♦ ***Eosin Y***



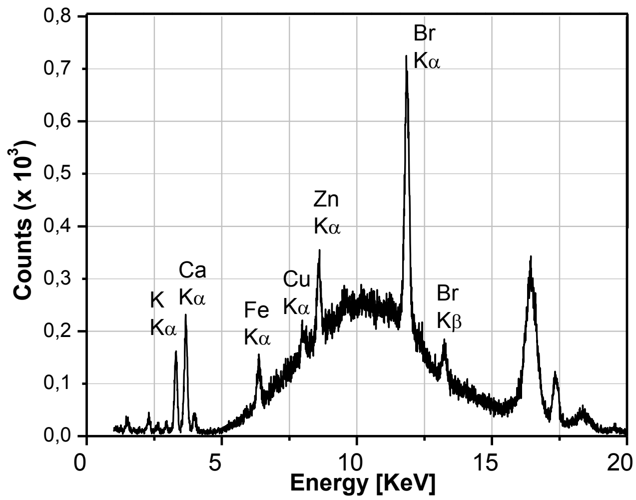
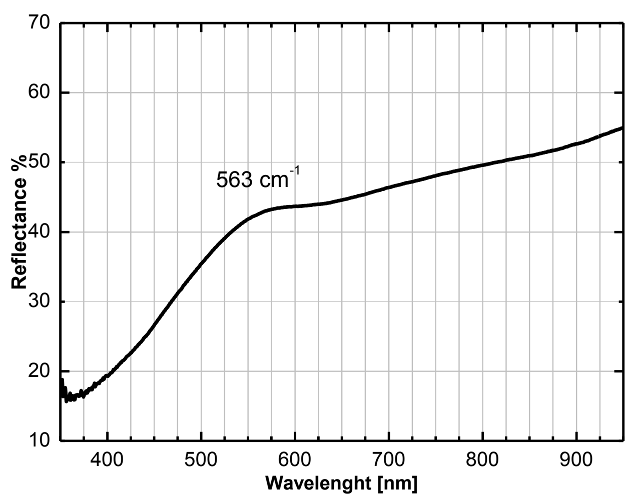


Figure IV.3.24. *On the left:* FORS spectrum of Eosin Y coloured letters acquired from p. 97 of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

♦ **Cover**

Emerald Green



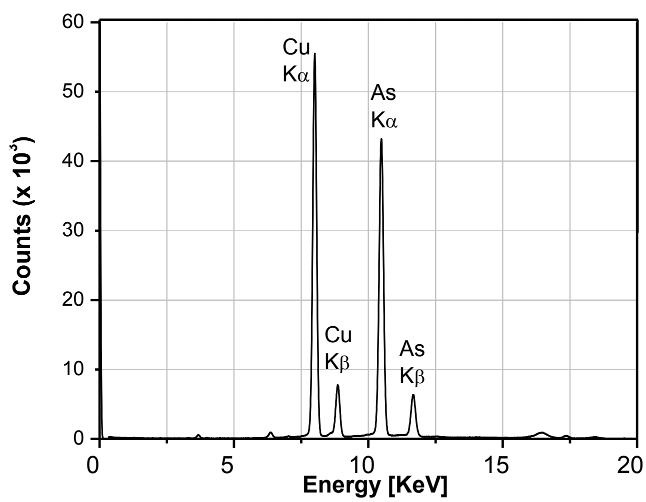


Figure IV-3.25. *On the left:* FORS spectrum of Emerald green+parchment from the cover of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

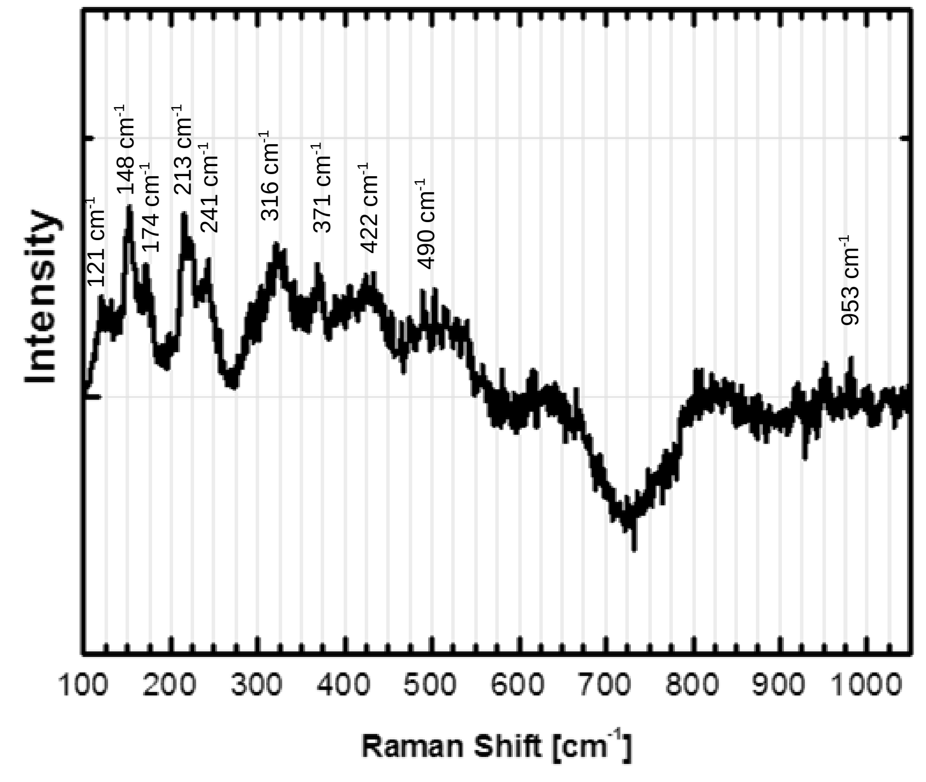
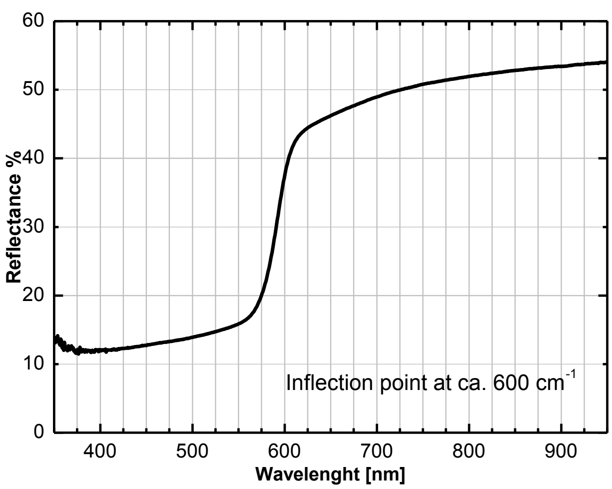


Figure IV-3.26. μ-Raman spectrum of Emerald green+parchment from the cover of *La Légende*.

Vermilion



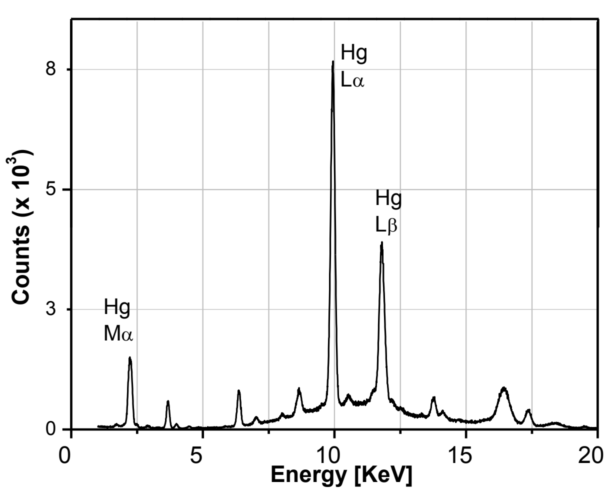


Figure IV.3.27. *On the left:* FORS spectrum of Vermilion from the cover of *La Légende*. *On the right:* μ-EDXRF spectrum from the same area.

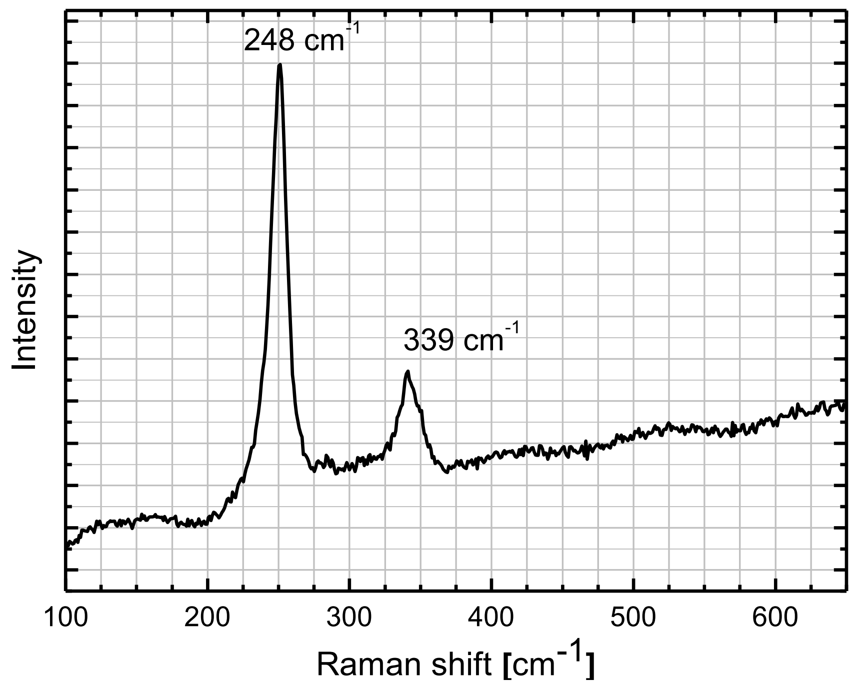


Figure IV-3.28. μ-Raman spectrum of Vermilion from the coverof *La Légende*.

Ultramarine blue

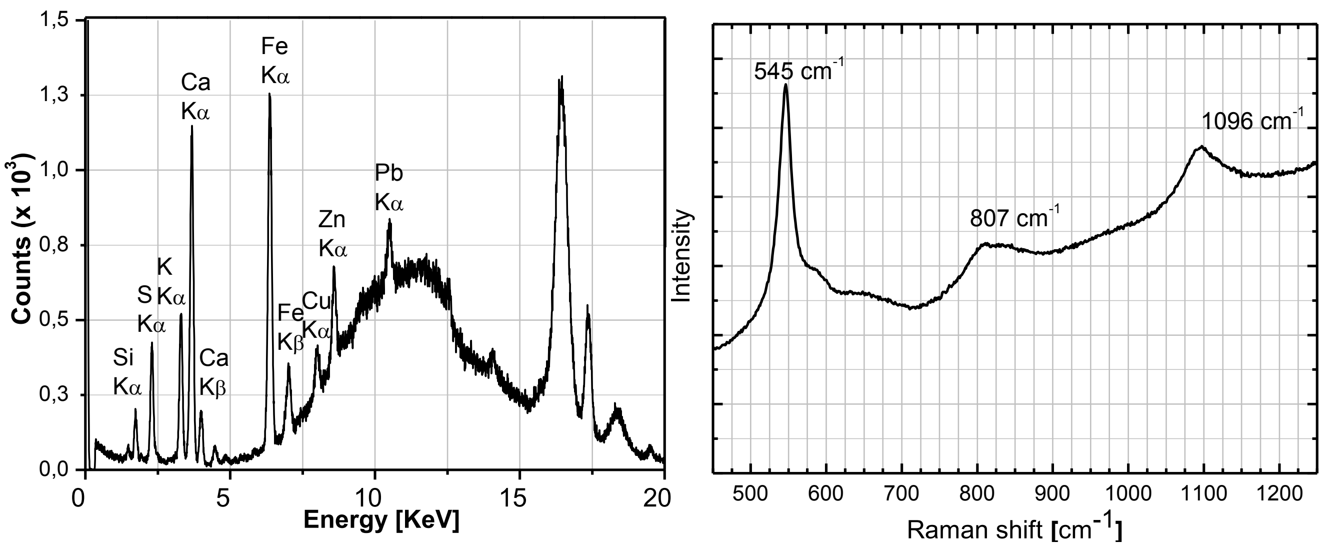


Figure IV-3.29. *On the left:* μ-EDXRF spectrum of Vermilion from the cover of *La Légende*. *On the right:* μ-Raman spectrum from the same area.

A4.4 – Résumé of results

Table IV.1. Potential and limitations of the techniques μ-EDXRF, FORS and μ-Raman in the analysis of Amadeo's palette in *La Légende de Saint Julien l'Hospitalier*.

Pigment/Dye	Compound	XRF	FORS	Raman
Cobalt violet	$Co_3(AsO_4)_2$	✓	✓	✓
Prussian blue	$Fe_4[Fe(CN)_6]_3\bullet 14H_2O$ or $KFe[Fe(CN)_6\bullet H_2O]$	✓	✓	✓
Ultramarine blue	$Na_{8-10}[Al_6Si_6O_{24}]S_{2-4}$	✓	✓	✓
Cobalt blue	$CoO\bullet Al_2O_3$	✓	✓	✓
Viridian	$Cr_2O_3\bullet 2H_2O$	✓	✓	✓
Emerald green	$Cu(C_2H_3O_2)_2\bullet 3Cu(As_2O_2)_2$	✓	✓	✓
Cobalt green	$CoO\bullet nZnO$	✓	✓	✓
Yellow ochre	α-FeO(OH) + aluminosilicates	✓	✓	✓
Cadmium yellow	CdS	✓	✓	✓
Cadmium orange	Cd(S,Se)	✓	✓	✓
Burnt Siena	Fe_2O_3 + aluminosilicates	✓	✓	✓
Vermilion	HgS	✓	✓[314]	✓
Carmine	Carminic acid: $C_{22}H_{20}O_{13}$	--	✓	--
Carbon black	C	--	--	✓
Gold	Au	✓	✓	--
Silver	Ag	✓	✓	✓
Eosin Y	$C_{20}H_8Br_4O_5$	--	✓	✓
Foundation white	$2PbCO_3\bullet Pb(OH)_2$ + ZnO	✓	✓	--

[314]However, FORS signal for Vermilion is similar for other red inorganic pigments, such as Cadmium red, as already referred in *Chapter 4*.

Table IV.2. *Résumé* of results from the analysis of the main pages selected from *La Légende*.

Page	Description	Colour	Hypothesis of pigment	Notes
p.2	Text	Orange	Cadmium orange	FORS: Cadmium orange
p.5	Tracery and Croce	Bordeaux	Carmine	FORS: Probably, carmine
	Golden elements	Gold	Gold	FORS: Gold
	Top of the coat of arms	White	(Paper)	FORS: Paper
	Background	Black	Carbon based pigment	FORS: Probably, carbon based pigment
p.21	Golden elements	Gold	Gold	FORS: Gold
	Skin	White	(Paper)	FORS: Paper
	Background		Carbon based pigment	FORS: Probably, carbon based pigment
p.24	Sun/Halo	Gold	Gold	FORS: Gold
	Plant	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	(Gum)	--	(Paper)	FORS: Paper
p.27	Golden elements	Gold	Gold	FORS: Gold
	Hat	White	(Paper)	FORS: Paper
	Leg	Black	Carbon based pigment	FORS: Probably, carbon based pigment
p.42	Golden elements	Gold	Gold	μ-EDXRF: **Au**, (Ca,Cu) FORS: Gold
	Boat	Black	Carbon based pigment	μ-EDXRF: **S, K, Ca**,(Fe) FORS: Probably, carbon based pigment
p.48	Dot	Orange	Cadmium orange	FORS: Cadmium orange
	Background	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Petals	Orange	Cadmium orange	FORS: Cadmium orange
	Roman number	Black	Carbon based pigment	FORS: Probably, carbon based pigment
p.52	Golden elements	Gold	Gold	FORS: Gold
	Circle	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Silver element	Silver	Silver	FORS: Silver
	Snake	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Text and dot	Bordeaux	Carmine	FORS: Probably, carmine
p.53	Tooth	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Coat of arms and flowers	Bordeaux	Carmine	FORS: Carmine
	Coat of arms	Gold	Gold	FORS: Gold
	Coat of arms	Green	Viridian	FORS: Viridian
	Coat of arms	Red	Vermilion	FORS: Inorganic red
	Mouth	Black	Carbon based pigment	FORS: Probably, carbon based pigment

Page	Description	Colour	Hypothesis of pigment	Notes
p.60	Text and dot	Dark brown	Burnt Siena	μ-EDXRF: (K, Ca), **Fe** FORS: Burnt Siena
	Moon and shape	Red	Vermilion	μ-EDXRF: **Hg** FORS: Inorganic red
	Circle	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Circle	Gold	Gold	FORS: Gold
p.62	Petals	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Leg	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Leg	Gold	Gold	FORS: Gold
	Mantle	White	(Paper)	FORS: Paper
p.65	Semi flower	Gold	Gold	FORS: Gold
	Coats of arms and dot	Red	Vermilion	μ-EDXRF: **Hg** FORS: Inorganic red μ-Raman: Vermilion
	Coat of arms	Yellow	Cadmium yellow	μ-EDXRF: **Cd, S**, (Zn) FORS: Cadmium yellow
	Coat of arms (Five shields)	Bordeaux	Carmine	μ-EDXRF: (K), **Ca**, (Fe, Cu, Zn), **Hg** FORS: Probably, carmine
	Coat of arms	Blue	Prussian blue	μ-EDXRF: **K**, (Ca), **Fe** FORS: Prussian blue μ-Raman: Prussian blue
	Petal	Black	Carbon based pigment	μ-EDXRF: **K, Ca, S**, (Fe) FORS: Probably, carbon based pigment
p. 66	Wings	Green	Emerald green	FORS: Prussian blue
	Black line and petal	Black	Carbon based pigment	FORS: Probably, carbon based pigment
p.74	Little flame and dot	Red	Eosin Y	FORS: Eosin Y
	Little dot	Gold	Gold	FORS: Gold
	Flower eye and text	Green	Cobalt green	FORS: Cobalt green
	Contour	Orange	Cadmium orange	FORS: Cadmium orange
p.80	Beasts	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Cherries	Bordeaux	Carmine	μ-EDXRF:(K), **Ca**, (Fe, Cu, Zn), **Hg** FORS: Carmine
	Lemon, cherry, pear and text	Red	Vermilion	μ-EDXRF: **Hg** FORS: Inorganic red μ-Raman: Vermilion
	Flower and text	Dark blue	Prussian blue	μ-EDXRF: (S), K, Ca, **Fe** FORS: Prussian blue μ-Raman: Prussian blue
	Leaf	Green	Emerald green	μ-XRF: **Cu**, **As** FORS: Emerald green μ-Raman: s.s
	Text	Green	Cobalt green	μ-EDXRF: **Co**, **Zn** FORS: Cobalt green μ-Raman: s.s

Page	Description	Colour	Hypothesis of pigment	Notes
p.80	Leaf	Orange	Cadmium orange	μ-EDXRF: (Se), S, **Cd**, (Fe), Cu, Zn FORS: Cadmium orange μ-Raman: Cadmium yellow
	Text	Yellow	Yellow ochre	μ-EDXRF: (K, Ca), **Fe** FORS: Yellow ochre μ-Raman: Yellow ochre
p.82	Flower eye, "H", "I" and "T"	Blue	Ultramarine blue	FORS: Ultramarine blue
	Petal	Red	Vermilion	FORS: Inorganic red
	Beast	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Beast (Head)	Orange	Cadmium orange	FORS: Cadmium orange
p.84	Triangle	Red	Vermilion	FORS: Inorganic red
	Little flower, petal and leaves	Green	Emerald green	FORS: Emerald green
	Flower eye, petal and leaf	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Beast	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Beast	Gold	Gold	FORS: Gold
p.87	Petals	Blue	Ultramarine blue	FORS: Ultramarine blue
	Dot	Green	Emerald green	FORS: Emerald green
	Feather and Croce	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Text	Violet	Cobalt violet	FORS: Cobalt violet
p.88	Hearts	Green	Emerald green	FORS: Emerald green
	Line, rhomb and text	Bordeaux	Carmine	FORS: Probably, carmine
	Knife	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Knife	Silver	Silver	FORS: Silver
p.91	Background, petals and dot	Orange	Cadmium orange	FORS: Cadmium orange
	Line	Scarlet	Eosin Y	FORS: Eosin Y
	Roman number	Black	Carbon based pigment	FORS: Probably, carbon based pigment

Note: s.s. – no signal.

Page	Description	Colour	Hypothesis of pigment	Notes
p.97	Coat of arms	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Coat of arms	Silver	Silver	μ-EDXRF: **Ag,** (S,Cl,Ca,Fe) FORS: Silver
	Crown, triangle and dot	Red	Vermilion	FORS: Vermilion
	Hexagon	Green	Emerald green	μ-EDXRF: **Cu**, **As** FORS: Emerald green μ-Raman: Emerald green
	Squares	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Border	Orange	Cadmium orange	μ-EDXRF: (Se, S), **Cd**, Cu, Zn FORS: Cadmium orange
	Text	Scarlet	Eosin Y	μ-EDXRF: (K, Ca, Fe, Zn), **Br** FORS: Eosin Y
p.99	Leg and feather	Red	Vermilion	μ-EDXRF: **Hg** FORS: Inorganic red
	Legs, feather, hat and flowers	Blue	Ultramarine blue	μ-EDXRF: Al, Si, S, K, Ca,Ti, Fe, Cu, Zn FORS: Ultramarine blue μ-Raman: Ultramarine blue
	Feather	White	(Paper)	FORS: Paper
	Jacket	Green	Emerald green	μ-EDXRF: **Cu**, **As** FORS: Emerald green μ-Raman: Emerald green
	Arms	Yellow	Cadmium yellow	μ-EDXRF: S, **Cd**, (Fe, Zn) FORS: Cadmium yellow μ-Raman: Cadmium yellow
	Weapon and borders	Orange	Cadmium orange	μ-EDXRF: (S), **Cd**, (Fe,Cu, Zn) FORS: Cadmium orange
	Text and weapon contour	Scarlet	Eosin Y	μ-EDXRF: (K,Ca,Fe,Zn) **Br** FORS: Eosin Y μ-Raman: Eosin Y
p.101	Beast and dot	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Leaves	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Leaf	Green	Emerald green	FORS: Emerald green
p.103	Coats of arms	Silver	Silver	μ-EDXRF: **Ag,** (S,Cl,Ca,Fe) FORS: Silver
	Coats of arms contours	Orange	Cadmium orange	μ-EDXRF: (Se), **S**, **Cd**, (Fe, Zn) FORS: Cadmium orange
	Mushrooms and small circle	Yellow	Cadmium yellow	μ-EDXRF: **Cd, S,** (Fe, Zn) FORS: Cadmium yellow μ-Raman: Cadmium yellow
	Dot (Five shields)	Orange	Cadmium orange	μ-EDXRF: (Se), **S**, **Cd**, (Fe, Zn) FORS: Cadmium orange
	Text	Black	Carbon based pigment	FORS: Probably, carbon based pigment

Page	Description	Colour	Hypothesis of pigment	Notes
p.104	Hexagon	Red	Vermilion	FORS: Inorganic red
	Dot, hexagon and pentagon	Green	Emerald green	FORS: Emerald green
	Coats of arms	Silver	Silver	FORS: Silver
	Text	Black	(Paper)	FORS: Paper
p.105	Coats of arms and circle	Silver	Silver	μ-EDXRF: (S, Cl), **Ag**, Fe, Zn FORS: Silver μ-Raman: Silver (AgCl)
	Crown	Red	Vermilion	μ-EDXRF: **Hg** FORS: Inorganic red μ-Raman: Vermilion
	Wings	Violet	Cobalt violet	μ-EDXRF: (K,Ca), **Co**, **As** FORS: Cobalt violet μ-Raman: Cobalt violet
	Text	Black	Carbon based pigment	FORS: Probably, carbon based pigment
p.108	Coats of arms	Silver	Silver	FORS: Silver
	Coat of arms	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Crowns	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Text	Scarlet	Eosin Y	FORS: Eosin Y
p.116	Beast	Black	Carbon based pigment	μ-EDXRF: S, K, Ca, Fe FORS: Probably, carbon based pigment μ-Raman: Carbon black
	Shadow	Gold	Gold	FORS: Gold
	Hammers	Blue	Ultramarine blue	μ-EDXRF: Al, Si, S, K, Ca,Ti, Fe, Cu, Zn FORS: Ultramarine blue μ-Raman: Ultramarine blue
	Text	Scarlet	Eosin Y	FORS: s.s. μ-Raman: Eosin Y
p.117	Knifes	Silver	Silver	FORS: Silver
	Knifes	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Wings and flames	Orange	Cadmium orange	FORS: Cadmium orange
p.119	Flower eye	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Beasts tail and dot	Green	Viridian	FORS: Viridian
	Beasts	Silver	Silver	FORS: Silver
	Contour	Orange	Cadmium orange	FORS: Cadmium orange
	Text	Scarlet	Eosin Y	FORS: Eosin Y

Page	Description	Colour	Hypothesis of pigment	Notes
p.123	Mantles and dot	Green	Viridian	µ-EDXRF: (S, Ca, K, Fe), **Cr** FORS: Viridian µ-Raman: Viridian
	Mantles	Violet	Cobalt violet	µ-EDXRF: (K, Ca), **Co**, **As** FORS: Cobalt violet µ-Raman: Cobalt violet
	Mantles and dot	Red	Vermilion	µ-EDXRF: **Hg** FORS: Inorganic red µ-Raman: Vermilion
	Mantle	Dark yellow	Yellow ochre	µ-EDXRF: (K, Ca), **Fe** FORS: Yellow ochre
	Mantles and dress	Yellow	Cadmium yellow	µ-EDXRF: (Se), **S**, **Cd**, (Fe, Zn) FORS: Cadmium yellow µ-Raman: Cadmium yellow
	Mantles and dress	Blue	Prussian blue	µ-EDXRF: (K, Ca), **Fe** FORS: Prussian blue
	Mantle, face and dress	Bordeaux	Carmine	µ-EDXRF: **(S)**, K, Ca, (Fe) FORS: Probably, carmine
	Arc	Silver	Silver	µ-EDXRF: **Ag**, (Ca, Fe, Cu, Zn, S) FORS: Silver
	Mantle, dress, arc, hairline and !	Orange	Cadmium orange	µ-EDXRF: **S**, **Cd**, (Fe, Zn) FORS: Cadmium orange µ-Raman: Cadmium yellow
	Dot, dolphin and 1/4 circle	Black	Carbon based pigment	µ-EDXRF: S, K, Ca, (Fe) FORS: Probably, carbon based pigment µ-Raman: Carbon black
p.124	Flags	Bordeaux	Carmine	µ-EDXRF: **Hg**, K, Ca, Fe, Zn FORS: Carmine
	Sail boats and compass	Silver	Silver	µ-EDXRF: (S, Cl, Ca, Fe), **Ag** FORS: Silver
	Sail boats	Black	Carbon based pigment	FORS: Probably, carbon based pigment
	Water and seagull	Blue	Prussian blue	µ-EDXRF: (K, Ca), Fe FORS: Prussian blue µ-Raman: Prussian blue
	Sail boat (line)	Green	Viridian	FORS: Viridian
	Sail boat (line)	Orange	Cadmium orange	FORS: Cadmium orange
p.131	Beast and head	Red	Vermilion	µ-EDXRF: Hg FORS: Inorganic red µ-Raman: Vermilion
	Dot	Gold	Gold	µ-EDXRF: (Ca), **Au**, (Cu) FORS: Gold
	Snakes	Yellow	Cadmium yellow	µ-EDXRF: S, **Cd**, Fe, Zn FORS: Cadmium yellow
	Palm	Black	Carbon based pigment	µ-EDXRF: S, K, Ca, (Fe) FORS: Probably, carbon based pigment

Page	Description	Colour	Hypothesis of pigment	Notes
p.134	Background and fleur de lis	Bordeaux	Carmine	μ-EDXRF: Hg, K, Ca, Fe FORS: Carmine μ-Raman: "lake"
	Rhombs	Red	Vermilion	μ-EDXRF: Hg FORS: Inorganic red μ-Raman: Vermilion
	Flower and fleur de lis	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Fleur de lis	Red	Vermilion	μ-EDXRF: Hg FORS: Inorganic red
	Fleur de lis	Green	Viridian	μ-EDXRF: (K, Ca), **Cr** FORS: Viridian μ-Raman: Viridian
	Small dot and shadows	Gold	Gold	μ-EDXRF: (Ca), **Au**, (Cu) FORS: Gold
	Lines and contour "E"	Yellow	Cadmium yellow	μ-EDXRF: S, **Cd**, Fe, Zn FORS: Cadmium yellow
p.136	Petals	Bordeaux	Carmine	FORS: Probably, carmine
	Petal, dot and dress	Red	Vermilion	μ-EDXRF: **Hg** FORS: Inorganic red μ-Raman: Vermilion
	River	Red	Vermilion	μ-EDXRF: **Hg** μ-Raman: Vermilion
	Flower	Blue	Prussian blue	μ-EDXRF: (K, Ca), **Fe** FORS: Prussian blue μ-Raman: Prussian blue
	Dot and boat shadow	Gold	Gold	FORS: Gold
	Flower	Bordeaux	Carmine	FORS: Probably, carmine
	Moon/halo and river	Silver	Silver	μ-EDXRF: S, **Ag** FORS: Silver μ-Raman: s.s.
	Text	Black	Carbon based pigment	FORS: Probably, carbon based pigment
p.137	Inner circle	Gold	Gold	μ-EDXRF: **Au**, (Cu) FORS: Gold
	Outer circle	Black	Carbon based pigment	μ-EDXRF: S, K, Ca, (Fe) FORS: Probably, carbon based pigment
p.139	1912	Red	Vermilion	μ-EDXRF: **Hg** FORS: Inorganic red μ-Raman: Vermilion
	Outer ring	Yellow	Cadmium yellow	μ-EDXRF: S, K, Ca, (Fe) FORS: Cadmium yellow
	Background	Black	Carbon based pigment	μ-EDXRF: S, Cd, (Fe, Zn) FORS: Probably, carbon based pigment

Note: s.s. – no signal.

Page	Description	Colour	Hypothesis of pigment	Notes
Cover and back cover	Parchment	--	Parchment	μ-EDXRF: (S),Ca, Fe, (Cu, Zn) FORS: Parchment
	Coat of arms	Green	Emerald green	μ-EDXRF: **Cu, As**, (Ca, Fe) FORS: Emerald green μ-Raman: Emerald green
	Coat of arms	White	Mixture of Lead White and Zinc White	μ-EDXRF: Zn, Pb FORS: Lead white + Zinc white
	Coat of arms	Red	Vermilion	μ-EDXRF: Hg, (Ca, Fe) FORS: Inorganic red μ-Raman: Vermilion
	Coat of arms	Blue	Ultramarine blue	μ-EDXRF: Al, Si, S, K, Ca,Ti, Fe, Cu, Zn μ-Raman: Ultramarine blue

Note: s.s. – no signal.

Table IV.3. *Résumé* of results from the analysis of the extra pages selected from *La Légende*.

Page	Description	Colour	Hypothesis of pigment	Notes
p.51	Flower and shadow	Green	Viridian	FORS: Viridian
p.55	Flame	Green	Viridian	FORS: Viridian
	Text	Orange	Cadmium orange	FORS: Cadmium orange
p.56	Flower and rhomb	Red	Probably, vermilion	FORS: Inorganic red
	Text	Orange	Cadmium orange	FORS: Cadmium orange
p.57	Frame	Green	Viridian	FORS: Viridian
	Insect	Orange	Cadmium orange	FORS: Cadmium orange
	Text	Scarlet	Eosin Y	FORS: Eosin Y
p.59	Flame	Red	Probably, vermilion	FORS: Inorganic red
	Frame	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Text	Green	Emerald green	FORS: Emerald green
p.63	Reddish element	Red	Probably, vermilion	FORS: Inorganic red
	Boat	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Text	Violet	Cobalt violet	FORS: Cobalt violet
p.67	Crown	Red	Probably, vermilion	FORS: Inorganic red
	Text and end-of-line	Green	Emerald green	FORS: Emerald green
p.68v	Page number	Violet	Cobalt violet	FORS: Cobalt violet
p.69	Text	Red	Probably, vermilion	FORS: Inorganic red
	Flower	Green	Emerald green	FORS: Emerald green
	Insect	Black	Probably, carbon based pigment	FORS: Inorganic black

Page	Description	Colour	Hypothesis of pigment	Notes
p.70	Croce	Gold	Gold	FORS: Gold
	Text	Yellow	Cadmium yellow	FORS: Cadmium yellow
p.71	Dot and text	Red	Probably, vermilion	FORS: Inorganic red
	Text	Blue	Prussian blue	FORS: Prussian blue
	Dot	Yellow	Cadmium yellow	FORS: Cadmium yellow
p.77	Beard and text	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Flower	Green	Emerald green	FORS: Emerald green
p.78	Text	Red	Probably, vermilion	FORS: Inorganic red
	Petal	Green	Emerald green	FORS: Emerald green
	Contour	Orange	Cadmium orange	FORS: Cadmium orange
	Little flower	Black	Probably, carbon based pigment	FORS: Inorganic black
p.81	Frame	Red	Probably, vermilion	FORS: Inorganic red
	Little flower and text	Green	Cobalt green	FORS: Cobalt green
	Dot (Beast tail)	Silver	Silver	FORS: Silver
p.85	Flower	Red	Probably, vermilion	FORS: Inorganic red
	Text	Yellow	Cadmium yellow	FORS: Cadmium red
p.89	Little flower	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Petal	Red	Probably, vermilion	FORS: Inorganic red
	Flower eye	Blue	Ultramarine blue	FORS: Ultramarine blue
	Text and end-of-line	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Frame and peacock	Green	Viridian	FORS: Viridian
	Dot (peacock tail)	Gold	Gold	FORS: Gold
p.93	Snake	Red	Probably, vermilion	FORS: Inorganic red
	Grapes	Green	Emerald green	FORS: Emerald green
	Text	Scarlet	Eosin Y	FORS: Eosin Y
p.94	Weapon	Red	Probably, vermilion	FORS: Inorganic red
	Weapon	Green	Emerald green	FORS: Emerald green
	Bluish element	Blue	Ultramarine blue	FORS: Ultramarine blue
	Text	Scarlet	Eosin Y	FORS: Eosin Y
p.109	Coats of arms	Silver	Silver	FORS: Silver
	Coat of arms (dot)	Black	Probably, carbon based pigment	FORS: Inorganic black
	Contour	Green	Viridian	FORS: Viridian
	Text	Scarlet	Eosin Y	FORS: Eosin Y
p.111	Contour	Green	Viridian	FORS: Viridian
	Text	Scarlet	Eosin Y	FORS: Eosin Y
p.112	Beast (eye) and petals	Orange	Cadmium orange	FORS: Cadmium orange
	Text	Scarlet	Eosin Y	FORS: Eosin Y
p.113	Beasts	Silver	Silver	FORS: Silver
	Frame	Blue	Ultramarine blue	FORS: Ultramarine blue
	Text	Scarlet	Eosin Y	FORS: Eosin Y

Page	Description	Colour	Hypothesis of pigment	Notes
p.115	Coat of arms	Silver	Silver	FORS: Silver
	Dot	Black	Probably, carbon based pigment	FORS: Inorganic black
	Text	Scarlet	Eosin Y	FORS: Eosin Y
p.125	Flags and coat of arms	Blue	Prussian blue	FORS: Prussian blue
	Flag	Red	Probably, vermilion	FORS: Inorganic red
	Coat of arms (Five shields)	Bordeaux	Probably, carmine	FORS: Probably, carmine
	Crown	Orange	Cadmium orange	FORS: Cadmium orange
	Text	Black	Probably, carbon based pigment	FORS: Inorganic black
p. 127	Cathedral	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Cloths	Red	Probably, vermilion	FORS: Inorganic red
	Line	Green	Viridian	FORS: Viridian
	Text	Black	Probably, carbon based pigment	FORS: Inorganic black
p. 128	Water and flower	Green	Viridian	FORS: Viridian
	Faces and line	Rose	Eosin Y	FORS: Eosin Y
	Text	Black	Probably, carbon based pigment	FORS: Inorganic black
p.129	Star	Red	Probably, vermilion	FORS: Inorganic red
	Cat whiskers (contour)	Orange	Cadmium orange	FORS: Cadmium orange
	Dot	Green	Viridian	FORS: Viridian
	Text	Black	Probably, carbon based pigment	FORS: Inorganic black
p.132	Petals	Yellow	Cadmium yellow	FORS: Cadmium yellow
	Contour	Green	Viridian	FORS: Viridian
	Text	Black	Probably, carbon based pigment	FORS: Inorganic black
p.135	Heart	Red	Probably, vermilion	FORS: Inorganic red
	Flower	Green	Viridian	FORS: Viridian
	Contour	Gold	Gold	FORS: Gold
	Text	Black	Probably, carbon based pigment	FORS: Inorganic black

Page/ Pigment or dye	Cobalt violet	Prussian blue	Ultramarine blue	Viridian	Emerald green	Yellow ochre	Cadmium yellow	Cadmium orange	Vermilion	Carmine	Carbon black	Gold	Silver	Cobalt blue	Cobalt green	Burnt Siena	Eosin Y
p. 2								•									
p. 5										•	•	•					
p. 21											•	•					
p. 24											•	•					
p. 27											•	•					
p. 42											•	•					
p. 48							•	•			•						
p. 52							•			•	•	•	•				
p. 53				•			•		•	•	•	•					
p. 60									•		•	•				•	
p. 62							•				•	•					
p. 65		•					•		•	•	•	•		•			
p. 66					•						•						
p. 74								•			•	•			•		•
p. 80		•			•	•		•	•	•	•						
p. 82			•					•	•		•						
p. 84					•		•		•		•	•					
p. 87	•		•		•						•						
p. 88					•					•	•		•				
p. 91								•			•						•
p. 97					•		•	•	•		•		•				•
p. 99			•		•		•	•	•		•						•
p. 101					•		•				•						
p. 103							•	•			•		•				
p. 104					•				•		•		•				
p. 105	•								•		•		•				
p. 108							•				•		•				•
p. 116			•								•	•					•
p. 117								•			•		•				
p. 119				•				•			•		•				•
p. 123	•	•		•		•	•	•	•	•	•		•				
p. 124		•		•				•		•	•		•				
p. 131							•		•		•	•					
p. 134				•			•		•	•	•	•					
p. 136		•							•	•	•	•	•				
p. 137											•	•					
p. 139							•		•		•						

Table IV.4. Pigments/Dyes found in each page of *La Légende de Saint Julien l'Hospitalier* (main pages).

A4.5 - Inflection points: first derivative

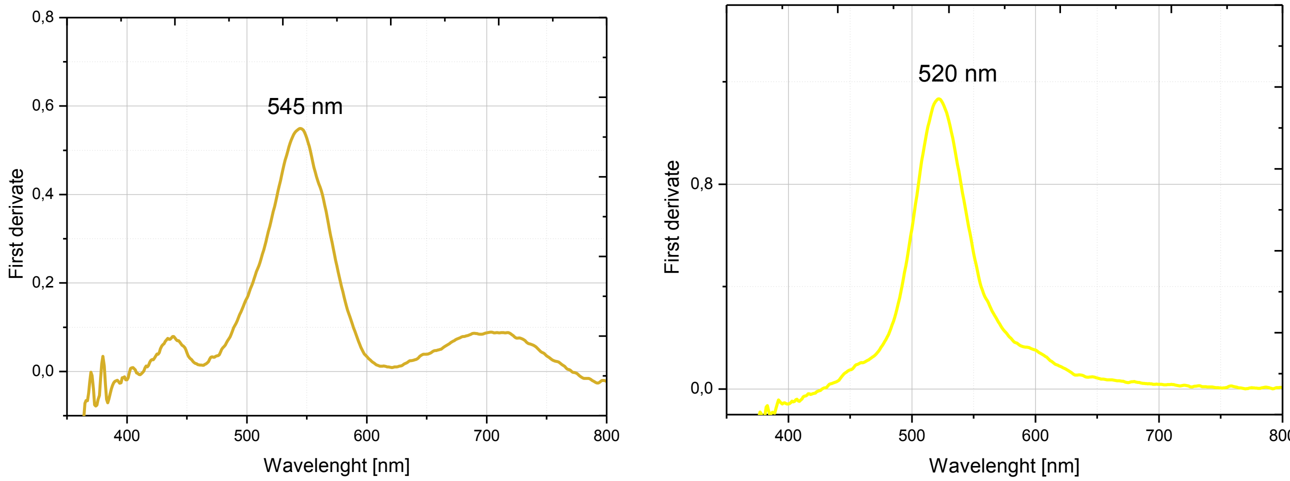


Figure IV.5.1. First derivate spectra: *On the left:* yellow ochre (p.123). *On the right:* cadmium yellow (p.103).

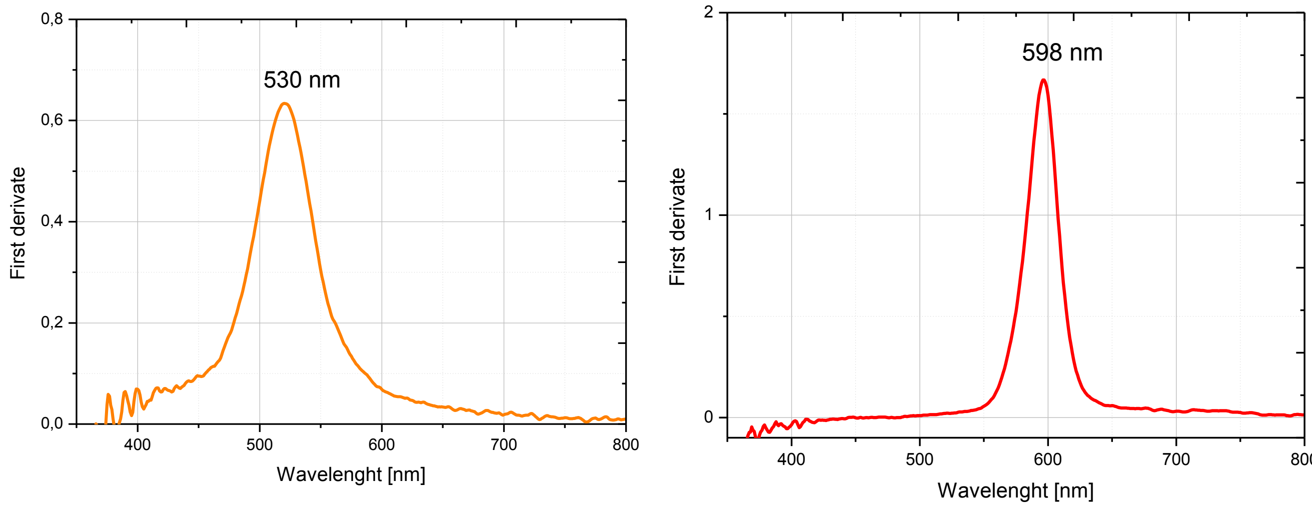


Figure IV.5.2. First derivate spectra: *On the left:* cadmium orange (p.80). *On the right:* vermilion (p.131).

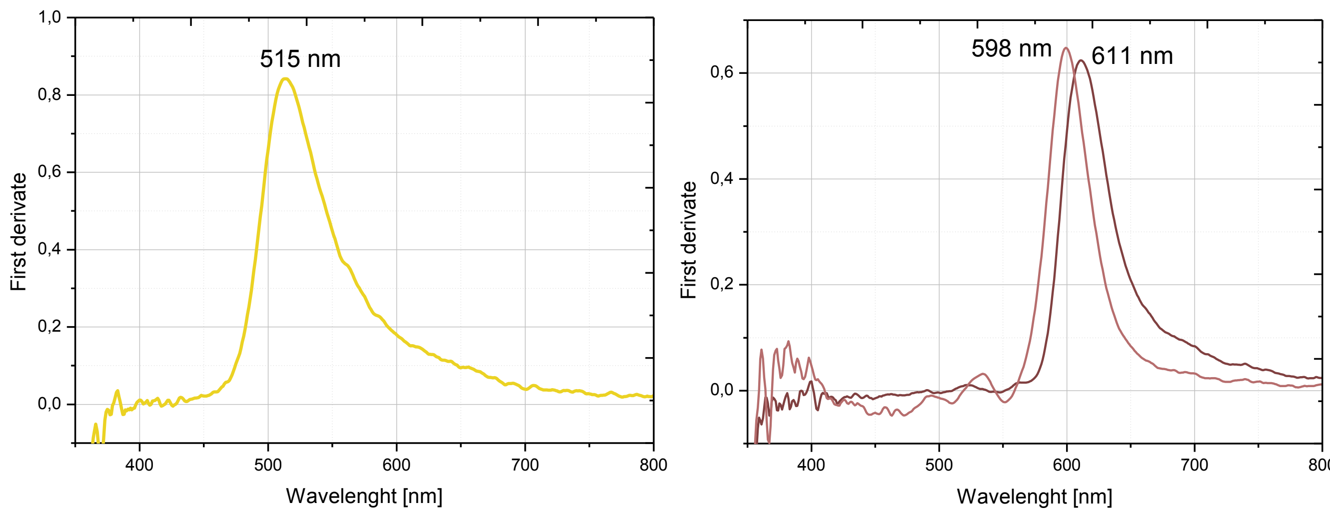


Figure IV.5.3. First derivate spectra: *On the left:* gold (p.137). *On the right:* carmine (p.134)

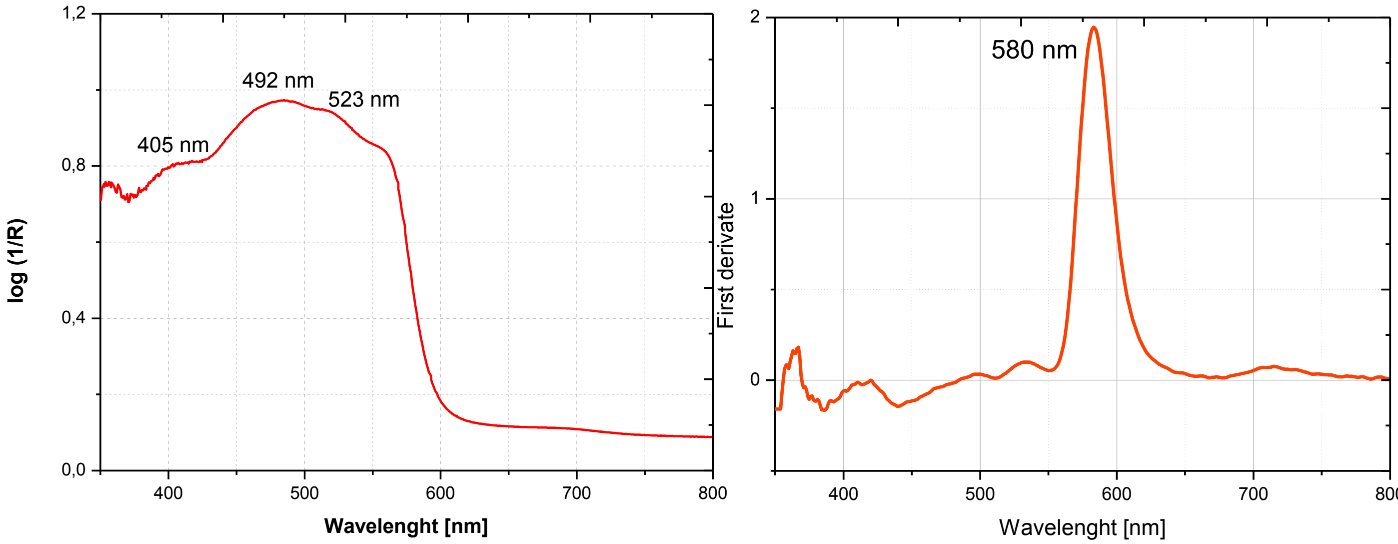


Figure IV.5.4. Eosin Y (p.99). *On the left:* Apparent absorbance spectrum. *On the right:* First derivate spectrum.

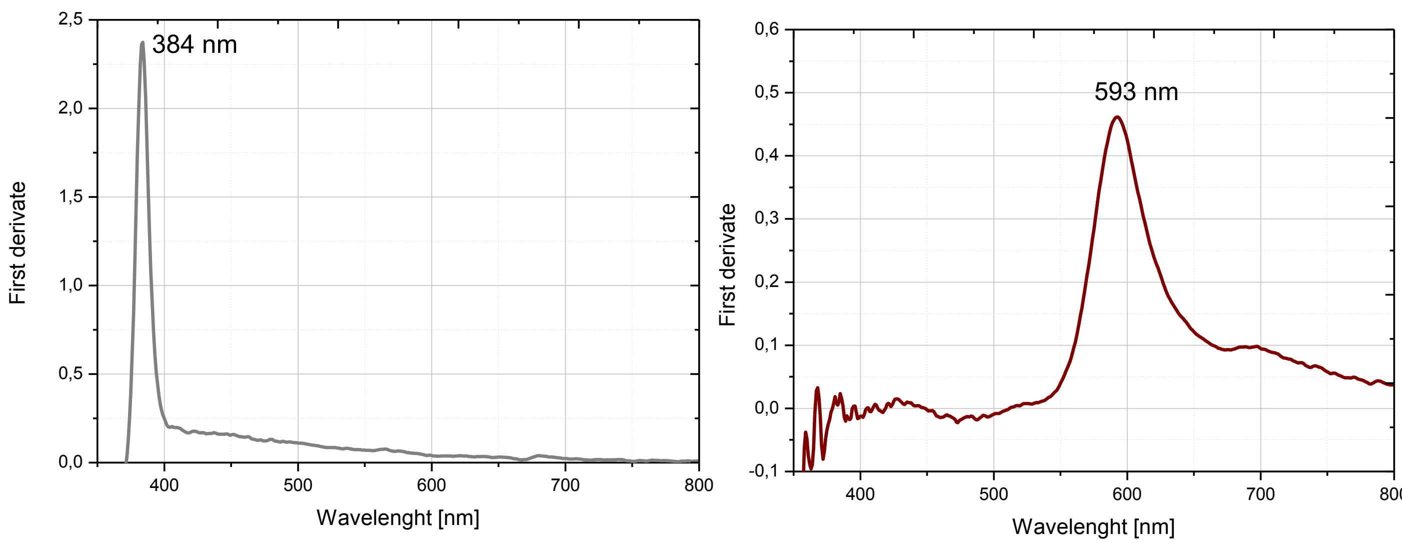


Figure IV.5.5. First derivate spectra: *On the left:* Foundation white (cover).
On the right: red lake (head of the pages).

A4.6 - Silver degradation: mechanisms

As already referred in ***Chapter 3, section 3.2.2*** and in ***section 4.2*** of the present chapter, silver's oxidation is the main conservation problem observed in *La Légende de Saint Julien l'Hospitalier*. In the following section, a literature review concerning the mechanisms of formation of degradation products in silver will be discussed. It is based on an ongoing critical analysis concerning this issue by Rita Araújo at DCR-FCT-UNL[315] and it will contribute for the establishment of accurate preventive conservation procedures for *La Légende* presented in ***Chapter 4, section 4.8***.

Tarnishing[316] of silver is a conservation problem commonly found in many museums throughout the world [Van Langh *et al.* 2004]. Under certain conditions, it results in the conversion of silver into degradation products due to the interaction with certain compounds prevalent in polluted atmosphere [Novakovic *et al.* 2013; Huo *et al.* 2016]. In pure silver materials, the main products formed are silver(I) sulphide (Ag_2S), silver(I) chloride (AgCl) and silver(I) oxide (Ag_2O) and they are easily produced in places where there are high pollution levels, like urban areas [Águas *et al.* 2008]. The influence of humidity and temperature is also crucial for the development of such degradation mechanisms [Novakovic *et al.* 2013]. ***Table IV.6.1*** shows the different compounds present in outdoor atmosphere.

Table IV.6.1 Chemical compounds of outdoor atmosphere [Schlager *et al.* 2012, 18; Menino-Homem 2013, 42].

Formula	Compound	Formula	Compound
Ar	Argon	N_2	Molecular nitrogen
CH_4	Methane	NH_3	Ammonic
$(CH_3)_2CO$	Acetone	N_2O	Dinitrogen oxide
ClO	Chlorine monoxide	Ne	Neon
$ClONO_2$	Chlorine nitrate	NO	Nitric oxide
CO	Carbon monoxide	NO_2	Nitrogen dioxide
CO_2	Carbon dioxide	NO_x	Nitrogen oxides
COS	Carbonyl sulphide	NO_y	Total reactive nitrogen
DMS	Dimethyl sulphide	O_2	Molecular oxygen
HCl	Hydrogen chloride	O_3	Ozone
HNO_2	Nitrous acid	OH	Hydroxyl radical
HNO_3	Nitric acid	PAN	Peroxyacetyl nitrate
H_2O	Water	PFC	Perfluorocarbons
H_2SO_4	Sulphuric acid	SO_2	Sulphur dioxide
He	Helium	VOC	Volatile organic compounds

Note: In blue are highlighted the main compounds present in a non-polluted outdoor atmosphere.

[315] PhD project: *The Books of Hours from the 15th century in Portuguese collections: matter, form and meaning*. The referred study will be published soon.
[316] This term designates the formation of an aesthetically displeasing blackish silver sulphide layer on the surface of silver [Menino-Homem 2013, 34; Novakovic *et al.* 2013].

As referred by Schlager *et al.* (2012), the regional and global distribution of these gases is determined by several factors: distribution, strength of their sources and sinks, transport and mixing in the atmosphere, chemical reactions, interaction with radiation, aerosols and clouds [Schlager *et al.* 2012, 19].

At the museums, outdoor pollutants can enter, especially in a naturally ventilated building, and compromise collections. Nevertheless, museums in general are equipped with heating, ventilation and air-conditioning systems that have gas-phase filtration. The most risky outdoor pollutants found in museums environment are sulfur dioxide (SO_2), nitrogen dioxide (NO_2), nitrogen oxide (NO_x), ammonia (NH_3), nitric acid (HNO_3), hydrogen peroxide (H_2O_2), ozone (O_3), hydrogen sulphide (H_2S), carbonyl sulphide (COS), hydrochloric acid (HCl). Acetic acid (CH_3COOH), formic acid (CH_2O_2), acetaldehyde (C_2H_4O), formaldehyde (CH_2O) and hydrogen sulphide (H_2S) are among the indoor-generated gases that may put in risk museums' collections. These gases can also be generated during activities such as heating, cleaning or cooking [Grzywacz 2006, 2; Tissot 2007, 3; Menino-Homem 2013, 43]. Visitors produce as well reduced sulphur compounds (H_2S) [Ankersmit *et al.* 2005]. Silver interacts with the compounds present in the atmosphere according to the nature of the atmosphere itself (external: rural, urban, marine or industrial; inside: natural and artificial methods of ventilation) [Menino-Homem 2013, 41]. In normal atmosphere, "solid silver"[317] does not form a significant surface oxide. This means that it is relatively chemical inert to oxidation under such conditions. Nevertheless, silver is very sensitive to relative humidity, temperature and to the presence of sulphur-based gases such as hydrogen sulphide (H_2S), carbonyl sulphide (COS), sulphuric acid (H_2SO_4), sulphur dioxide, dimethyl sulphide (DMS). This results in a loss of glossiness and darkening of silver surface. In polluted atmospheres, the concentrations of these corrosive gases are less than one parts per billion (ppb), when compared with normal atmosphere. In heavy industrial environment, these values can reach hundreds of ppb [Novakovic *et al.* 2013; Huo *et al.* 2016, Tissot *et al.* 2016]. The sources of those gases are oil refineries, paper treatment plants, kitchens, rubber, paints, etc. In most cases, the main component resulting from atmospheric corrosion on silver is silver sulphide (Ag_2S) [Gettens 1961; Novakovic *et al.* 2013]. When a silver surface is exposed to high sulphide containing atmosphere, it starts presenting a dull appearance with a colour variation from yellow to dark grey [Tissot *et al.* 2016]. The formation of Ag_2S can also be influenced by concentrations of parts per trillion (ppt) of compounds such as HCl, O_3 and NO_2. These compounds, as well as UV radiation accelerate the degradation mechanisms [Tissot 2007, 3-4]. Silver chloride (AgCl) is another important degradation component [Gettens 1961]. Its formation may occur due to the deposition of chloride-containing airborne particles from combustion processes, dispersion of marine salts and purification treatments of water in urban areas [Novakovic *et al.* 2013].

[317]As explained by Novakovic *et al.* (2013), "solid silver" is an alloy composed by other metals, partly to increase the hardness and also to reduce the amount of silver used. Copper is the major alloying element but lead, zinc and gold are also present as impurities [Menino-Homem 2013, 9; Novakovic *et al.* 2013].

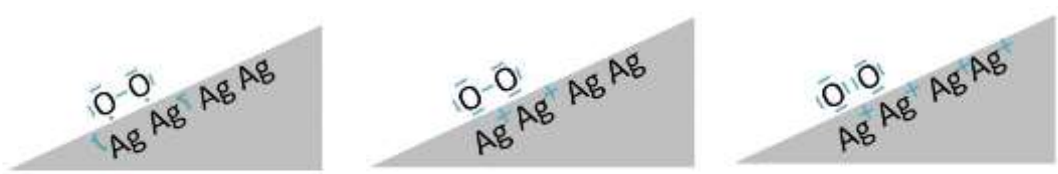
In the Cultural Heritage field, silver surfaces are usually preserved in inner spaces. However, the degradation processes occur but in a slow rhythm as well as the darkening of the surface [Menino-Homem 2013, 1].

In what concerns Amadeo's *La Légende de Saint Julien l'Hospitalier*, as referred in the ***General Introduction*** and ***Chapters 1 and 2*** of this dissertation, the manuscript was kept by Lucie de Souza-Cardoso after the artist's death. However, as already referred in this dissertation Amadeo travelled with *La Légende* at least between Brittany, Paris, Manhufe, Porto and Lisbon. Finally, it was only preserved by FCG since 1987. These facts may have also contributed for the degradation of the silver painted areas. In ***Chapter 4, section 4.2*** the results from the analytical characterisation of those areas of *La Légende* is described. In those painted areas, the presence of silver sulphide and silver chloride was identified. The formation of these compounds will be described in the present section.

A literature review was presented above. In the pages to come, an overview of the mechanisms of silver corrosion based in the preliminary results of the already referred ongoing critical analysis by Rita Araújo will be shown. From the Cultural Heritage field, Araújo highlights recent contributes, namely Isabel Tissot's study which presents an attempt to electrochemically revert silver degradation products [Tissot 2007; Tissot *et al.* 2016] and Paula Menino-Homem's research on the factors that contribute to silver atmospheric corrosion [Menino-Homem 2013]. Both studies present a review of the mechanisms inherent to silver degradation according to recent literature.

a) Formation of silver oxide (Ag_2O)

The first stage of silver corrosion deals with the formation of the first degradation product – silver oxide (Ag_2O). This mechanism begins with the interaction between oxygen and silver surface. Contrarily to other metals, silver is thermodynamically noble. At room temperature and pressure values and when exposed to atmospheric oxygen, the thickness of the formed oxide depends on the relative humidity[318] (RH) value [Menino-Homem 2013, 45]. This step occurs in a few seconds and is now known thanks to the development of several surface analytical characterization techniques [Menino-Homem 2013, 45].



step 1	step 2	step 3
O_2 adsorved Ag surface	1st e^- transfer from Ag to O	2nd e^- transfer $\rightarrow$ $2Ag_2O$

Figure IV.6.1. Mechanism of formation of Ag_2O (Based on Rita Araújo's study).

[318]HR is expressed in% and is defined as the ratio between absolute humidity of sampled air and the absolute humidity of saturated air at the same temperature [Casanovas 2008, 86].

According to Rita Araujo's study, ***Figure IV.6.1*** shows the sequence of reactions that explain the formation of Ag_2O. These oxidation-reduction reactions can be described according to the following global equation (E^0= 0.43 V; ΔG^o =-16.598 KJ/mol; K_{sp}= $3.6x10^{-11}$).

$$O_{2\,(g)} + 4Ag_{(s)} \rightarrow 2Ag_2O_{(s)} \qquad (4.1)$$

Literature refers that the impinging O_2 molecules dissociate at the metal surface in ions of unspecified charge. At this point, on the surface, some form of oxygen molecules (O_2^{2-}) and atoms (O^{2-}) must coexist from oxygen exchange work.

$$O_2\,(g) \rightarrow O_2\,(ads) \rightarrow O_2^{2-}(ads) \rightarrow 2O^{2-}(ads) \qquad (4.2)$$

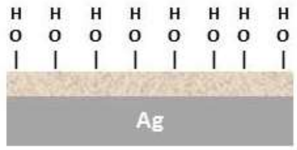
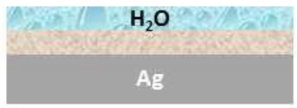
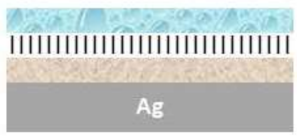
The oxygen molecules are adsorbed and subsequently dissociated with negligible activation energy (3 Kcal/mol). Oxygen atoms adsorption sites of occur in tetrahedral holes of the array of three silver atoms in a faced centered cubic packing [Czanderna 1964]. This process continues as long as adjacent sites are available to accept the two oxygen atoms from each dissociated molecule. The adsorption process has a random nature which restrict surface from being completely covered by charged atoms due to the fact that some silver atoms would become isolated in clusters of insufficient size and therefore unable to dissociate oxygen molecules. Charged oxygen molecules will also be adsorbed in a more highly activated process (8 Kcal/mol) [Czanderna 1964; Menino-Homem 2013, 45].

From a Thermodynamic point of view, the formation of the film of Ag_2O is favored since the enthalpy of formation of silver (I) oxide [ΔH_f (Ag_2O) = -60.6KJ/mol/O_2] is lower than the heat of adsorption of atomic oxygen [ΔH = -177.2KJ/mol/O_2]. The presence of RH of ca. 2-5% may catalyze the process [Menino--Homem 2013, 45-48].

In the following step, the oxidized silver surface interacts with humidity very quickly, if the RH is of ca. 15% and depending of the exposure time. This fact leads to the hydroxylation of the surface. The hydroxyl groups formed at the surface will act afterwards in the adsorption of water in the molecular form, originating a thin layer of water. Later, this layer will work as electrolyte to several electrochemical reactions (***Table IV.6.2***) [Menino-Homem 2013, 46].

At the beginning, the Ag_2O film is colourless and thin. In the following stages, due to the increase in thickness it becomes grey [Martina *et al.* 2012; Menino-Homem 2013].

Table IV.6.2. Scheme of the processes that occurs at oxidized silver surface in the presence of water and without any complexion agents [According to Menino-Homem 2013, 47].

Process	***Illustration***	***Result***
Dissociation of water and its adsorption to the oxidized silver surface		Hydroxylation of silver(I) oxide
Water adsorption		Formation of an aqueous layer
Electrochemical reactions		Formation of oxides and hydroxides

b) Formation of silver sulphide (Ag_2S), silver chloride (AgCl) and other silver salts

The research carried out by Rita Araújo suggests that the other products formed from silver degradation, occur due to a ligand exchange mechanism. This is determined by the solubility product constant (K_{sp}) (***Table IV.6.3***) and justifies the formation of silver sulphide (Ag_2S) as well as of chlorides (AgCl), sulphates (Ag_2SO_4) and hydroxides [AgOH and $Ag(OH)_2$].

Table IV.6.3. Solubility product constant (K_{sp}) for silver salts at 25ºC [Lide 2003; Dean 1999; Menino-Homem 2013, 77].

Compound	***Ksp***
Ag_2O	3.6×10^{-11}
AgOH	1.1×10^{-4}
Ag_2S	6.0×10^{-51}
AgCl	1.8×10^{-10}
$AgSO_4$	1.4×10^{-5}

The mechanism of formation of AgCl may occur also through a direct reaction as described for oxygen in ***Figure IV.6.1***. It is worth to refer that AgCl is white. However, since it is photosensitive, it can grow dark when exposed to light [Salvadò *et al.* 2011; Martina *et al.* 2012; Menino-Homem 2013].

As previously referred, among the many pollutants present at museums' environment, the reduced sulphur compounds COS and H_2S are largely responsible for the tarnishing of silver. The former presents residence time value of ca. 1 year and the latter of about 24 hours. Thus, COS is considered a threat from silver artworks [Ankersmit *et al.* 2005; Menino-Homem 2013]. The reactions of COS and H_2S with silver surface are described by the following reactions [São João 2016, 2]:

$$O_2 (g) + 4Ag (s) + 2COS (g) \rightarrow 2Ag_2S (s) + 2CO_2 (g) \quad (4.3a)$$

$$O_2 (g) + 4Ag (s) + 2H_2S (g) \rightarrow 2Ag_2S (s) + 2H_2O (g) \quad (4.3b)$$

Thus, the mechanism that occurs after the formation of the Ag_2O film (when silver is in the Ag^+ coordination) and in the presence of atmosphere pollutants with sulphur, silver will bound to the sulphur ion, S^{2-}. This ligands exchange between O^{2-} and S^{2-} ions occurs due to the dimensions of the electron cloud. For silver it will be also easy to coordinate with S^{2-} ions [Menino-Homem 2013].

References:

Águas H.; Silva R.J.C.; Viegas M.; Pereira L.; Fortunato E.; Martins, R. "Study of environmental degradation of silver surface." *Physica Status Solidi C, 5* (2008): 1215-18.

Ankersmit, H.A.; Tennent, N.H.; Watts, S.F. "Hydrogen sulfide and carbonyl sulfide in the museum environment – Part 1." *Atmospheric Environment, 39* (4) (2005): 695-707.

Czanderna, A.W. "The adsorption of oxygen on silver." *Journal of Physical Chemistry, 68* (10) (1964): 2765-71.

Dean, J.A. *Lange's Handbook of Chemistry* (15th edition). New York: Mc Graw Hill, 1999.

Gettens, R.J. "Mineral alteration products on ancient metal objects." *Studies in Conservation, 6* (1961): 89-92.

Grzywacz, C.M. *Monitoring for Gaseous Pollutants in Museum Environments*. Los Angeles: Getty Publications, 2006.

Huo, Y.; Fu, S.W.; Chen, Y.L.; Lee, C.C. "A reaction study of sulfur vapor with silver and silver-indium solid solution as a tarnishing test method." *Journal of Material Science-Materials in Electronics, 27* (2016): 10382-92.

Lide, D.R. (ed.) *CRC Handbook of Chemistry and Physics* (84th edition). Boca Raton, Florida: CRC Press LLC, 2003.

Menino-Homem, P. *Corrosão Atmosférica da Prata – Monitorização e perspectivas de conservação preventiva*. PhD dissertation. Porto: FLUP, 2013.

Novakovic, J.; Vassilion, P.; Georgiza, E. "Electrochemical cleaning of artificially tarnished silver." *International Journal of Electrochemical Science* (2013): 7223-32.

São João, J. *Desenvolvimento de géis de líquido iónico para a redução do sulfureto de prata.* Master dissertation. Lisbon: FCT-UNL, 2016.

Salvadò, N.; Buti, S.; Labrador, A.; Cinque, G.; Emerich, H.; Pradell, T. "SR-XRD and SR-FTIR study of the alteration of silver foils in medieval paintings." *Analytical and Bioanalytical Chemistry, 399* (2011): 3041-52.

Schlager, H.; Grewe, V.; Roiger, A. "Chemical composition of the atmosphere." In *Atmospheric Physics*, edited by U. Schumann, 17-35. Berlin: Springer-Verlag Berlin Heidelberg, 2012.

Tissot, I. *A protecção por polímeros condutores de objectos de ourivesaria de interesse cultural*. Master dissertation. Lisbon: FCUL, 2007.

Tissot, I.; Monteiro, O.C.; Barreiros, M.A.; Corregidor, V.; Correia, J.; Guerra, M.F. "Corrosion of silver alloys in sulphide environments: a multianalytical approach for surface characterization." *RSC Advances, 6* (2016): 51856-63.

Van Langh, R.; Ankersmit, H.A.; Joosten, I. "The delamination of silver sulphide layers." Proceedings from *Metal 2004 National Museum of Australia*. Camberra (October 4-8, 2004): 137-41.

A4.7– Binding medium

Chemometrics methodology

For the determination of the binding media present in Amadeo's palette in *La Légende de Saint Julien l'Hospitalier*, a method based on Principal components analysis (PCA) [Jolliffe 2002] was applied on FORS spectra. Arabic gum and egg white, two of the most common binding media present in manuscripts were tested. For the purpose, a set of mock-ups were prepared in laboratory: Arabic gum in different concentrations (Arabic gum in water in concentrations of 10%, 20%, 30%, 40% and 50% (w/v)) were applied in laboratory *Whatman* paper (filter paper) as well as mock-ups of egg white. A PCA model was built using part of the NIR region more sensible to binding media while insensitive to the presence of some pigments. The selected wavelength range was 1722 - 2120 nm. Before building the PCA model, FORS spectra were processed using a baseline slope correction, standard normal variate (SNV), Savitzky-Golay filter with 15-points window size, 2nd order polynomial and 1st derivative. The set of processed spectra was then mean centred before calibrating the PCA model. The uncertainty in the estimation of samples' PCA scores was performed resourcing to a bootstrapping strategy estimated according to a bootstrapping method. More details on this procedure can be consulted in [Babamoradi *et al.* 2013].

References:

Jolliffe, I. T. *Principal Component Analysis* (2nd edition). New York: Springer, 2002.

Babamoradi, H.; Van den Berg, F.; Rinnan, A. "Bootstrap based confidence limits in principal component analysis – A case study." *Chemometrics and Intelligent Laboratory Systems, 120* (2013): 97-105.

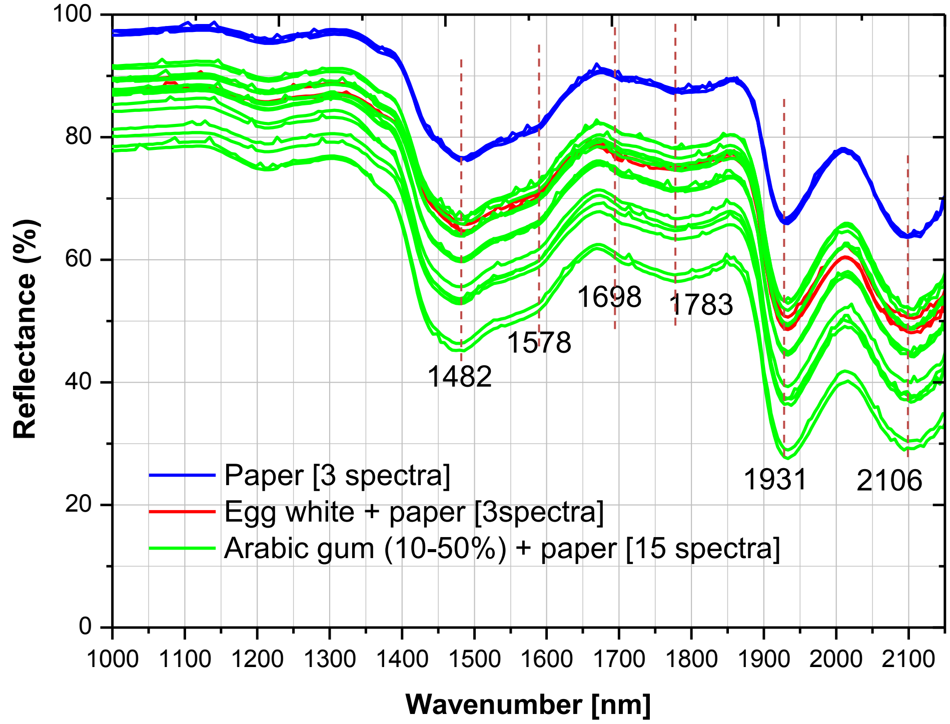


Figure IV-7.1. FORS spectra (paper, paper+egg white, paper+arabic gum (10-50%).

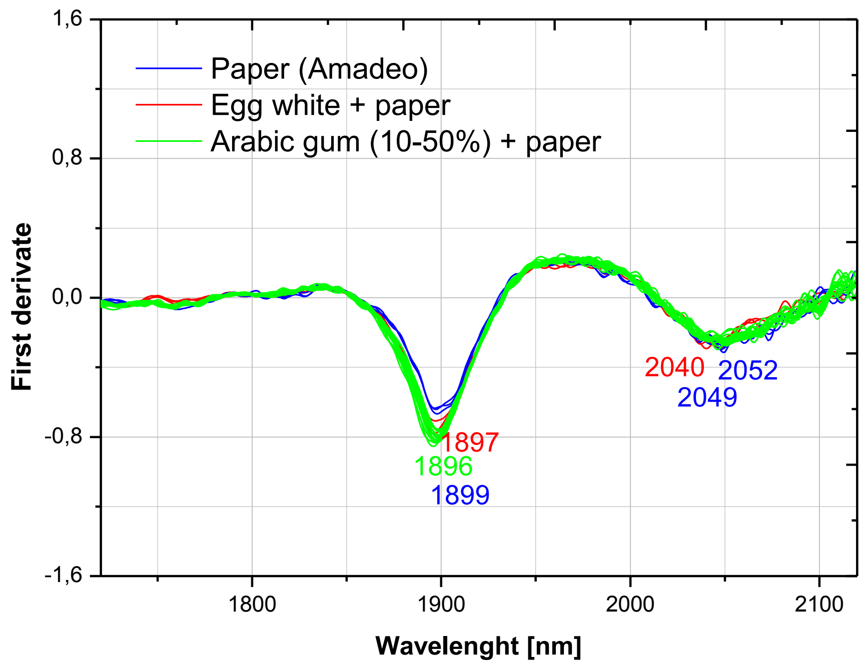


Figure IV-7.2. First derivate spectra obtained from the previous FORS spectra (1720-2120 nm).

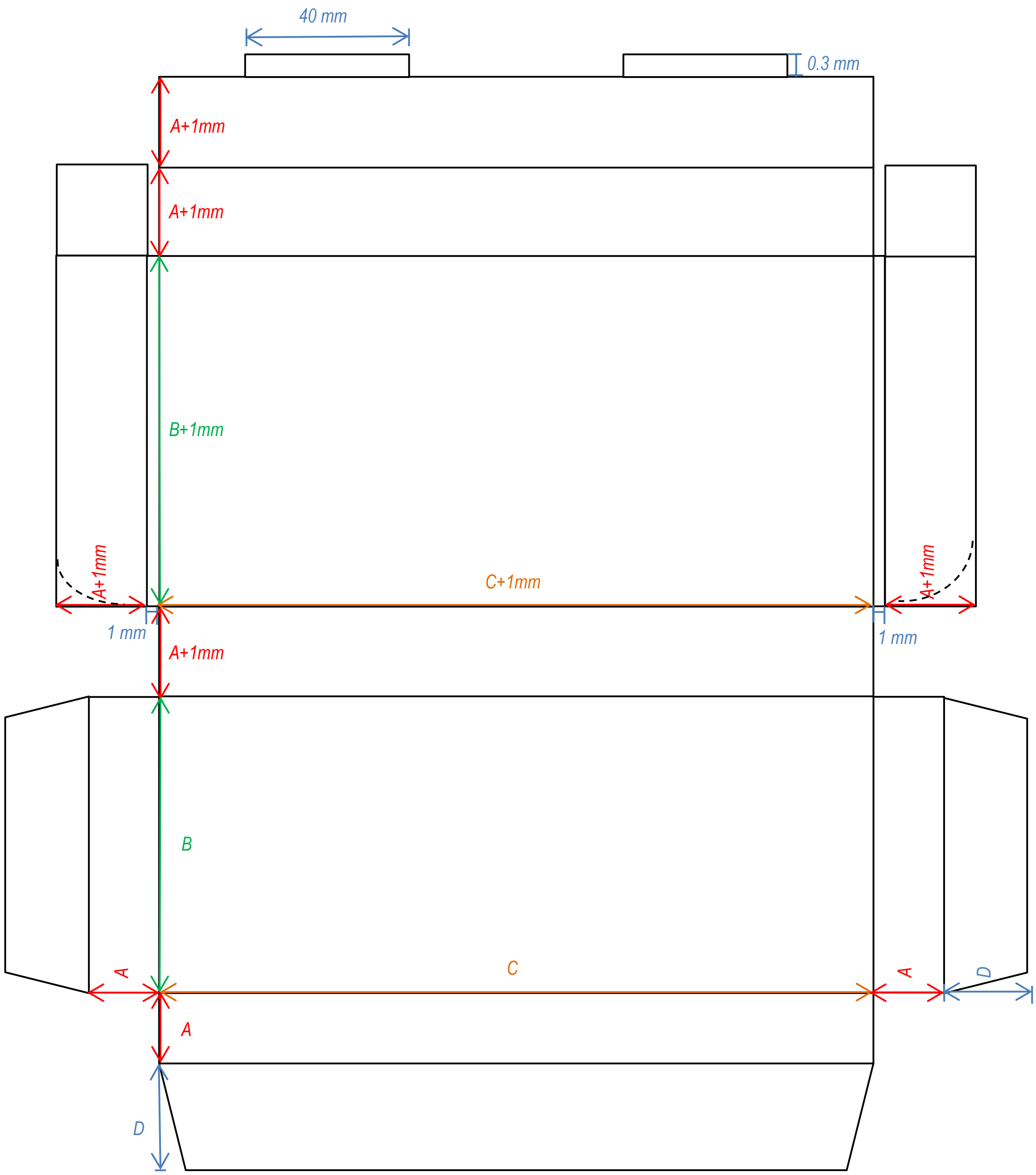
A4.8 – Colour mapping

The methodology followed in the colour mapping of *La Légende de Saint Julien l'Hospitalier* was the same used in other similar studies carried out at DCR-FCT-UNL concerning medieval illuminations.

After the analytical characterisation of the pages selected for the study of the materials and techniques used by Amadeo de Souza-Cardoso, the CIELAB parameters of some of those areas were selected for the construction of CIELAB colour palette (calibration matrix). These parameters were obtained from FORS analysis, since the software used with this technique (*Aspect Plus*) allows the simultaneous acquisition of colorimetric coordinates. Paper CIELAB was also considered as "background colour".

The determination of the areas occupied by each colour, used by the artist in all the manuscript, was obtained using an in-house built MATLAB function (MATLAB 7.11.0 R2010b). The image is then loaded in a RGB format and calibrated by an automatic adjustment gamma correction, which minimises the difference between average colour chosen areas of the image and the corresponding colours of the palette used for calibration. Afterwards, the image is converted to CIELAB format (3D data). The CIELAB parameters of the calibration matrix are overlapped to the image. It is adjusted to the latter through an optimization algorithm based on Kohonen neutral network. The role of this algorithm is to re-adjust the position of the centroids of the calibration colours, to optimally fit the image. Afterwards, each pixel of the image is analysed and ascribed to the closest colour from the calibration matrix, using Euclidean distance. At this distance, the CIELAB coordinates of image and calibration matrix weigh the same. The image pixels are then replaced by the calibration colours ascribed to them. A mask image is obtained. Finally, the pixels of the background colour (paper) are removed and the percentages corresponding to the colour mapping are calculated.

A4.9 – Drawing and dimensions for the conservation box



A= height: 55 mm
B= width: 245 mm
C= lenght: 280 mm
D= 40 mm

Figure IV-9.1. Suggested drawing and dimensions for *La Légende*'s conservation box.

***A4.10* – Pourbaix diagram**

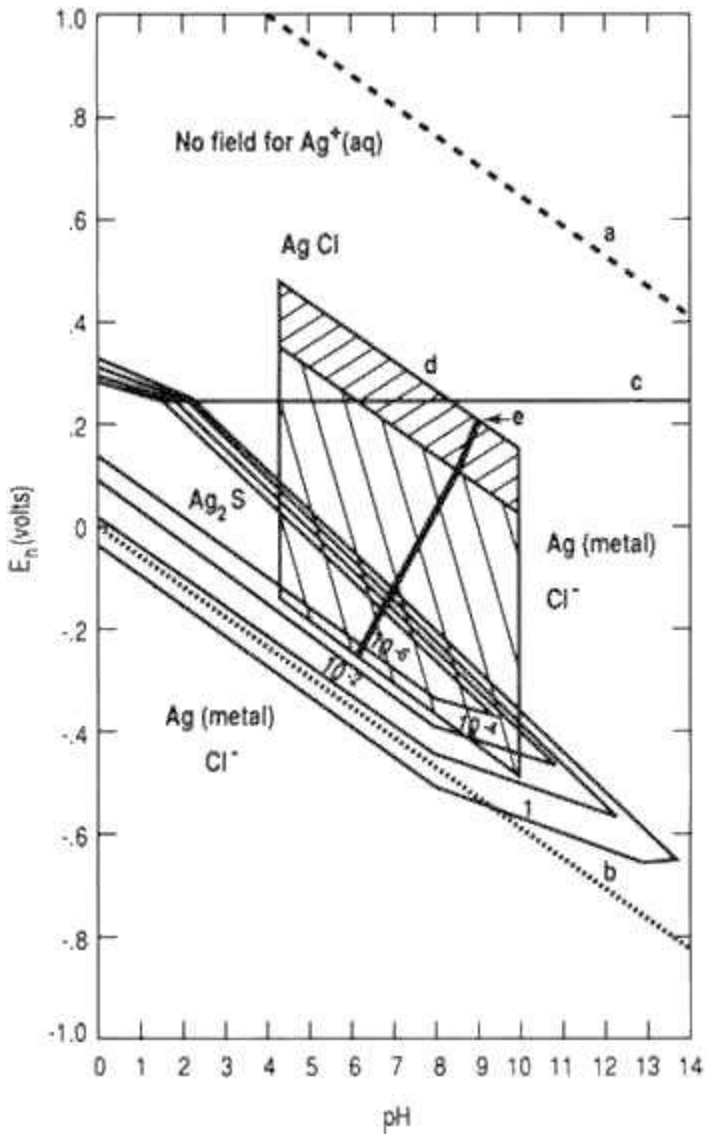


Figure IV-10.1. Stability diagram for silver in seawater at varying reduced sulphur concentrations.

Reference:

McNeil, M.B. and Little, B.J. "Corrosion mechanisms for copper and silver objects in near surface environments.", *Journal of the American Institute of Conservation*, 31 (number 3, article 7) (1992): 355--66.

A6.1 – Amadeo's oil paint tubes

Table VI.1. Oil paint tubes found in Amadeo's family's estate in Manhufe [Vilarigues *et al.* 2009, 39].

Jaune de Chrome – tempera farge
Rouge de Cadmium – Lefranc (serie P)
Rouge carmine – Bourgeois
Cerulean blue – W&N
Blanc de zinc – Lefranc, Paris
Goma-Gutte (Gamboge) – Bourgeois
Violet de cobalt – Lefranc
Carmine - Lefranc
Vert de cobalt – Bourgeois
Naples yellow – Bourgeois
J. de Chrome foncé – Lefranc
Vert de cadmium – Lefranc
Antwerpen blue – W&N
Vert Emerald – Lefranc
Brown Madder – W&N
Cadmium orange – W&N
French vermilion – W&N
Cobalt blue (oil colour) – W&N
Rouge de cadmium Claire – Lefranc
Chinese vermilion – W&N
Raw Siena – W&N
Olive green – W&N
Lacque fine, Laque Andrinople – Lefranc
Yellow ochre – W&N
Indigo – W&N
Ivory black – W&N
Terra Rosa – Rembrandt oil colours (Holand/USA)

Reference:

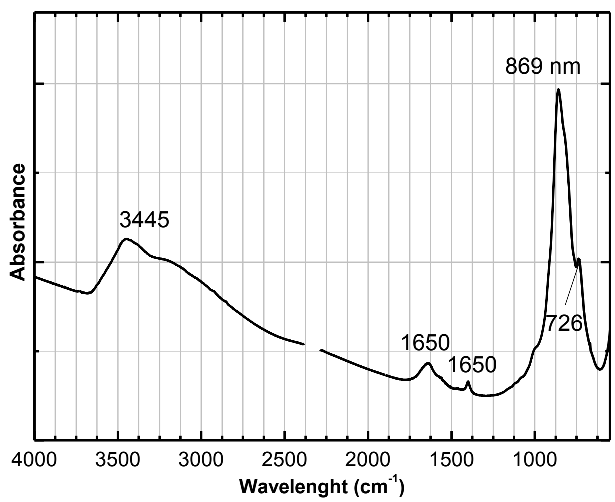
Vilarigues, M.; Melo, M.J. and Babo, S. "Estudo dos materiais e técnicas de Amadeo de Souza-Cardoso." Technical report. Monte de Caparica: DCR-FCT-UNL, 2009.

A6.2 – Pigment's confirmation: μ-EDXRF, μ-FTIR and μ-Raman analysis

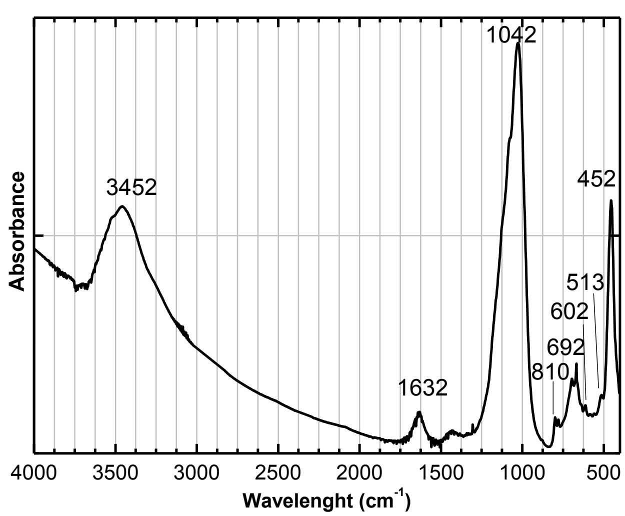
♦ **Equipment**

All pigments/dyes were characterized by μ-EDXRF [see ***Appendix A4.1.***]. IR spectra were acquired in transmittance mode by means of a Nicolet-Protégé TM 460 E.S.P.TM spectrophotometer in the 4000--400 cm^{-1} spectral range (64 scans; 4 cm-1 resolution). Each pigment/dye was placed in a potassium bromide (KBr) disc (pigment concentration ca. 0.1% w/w). Some pigments were instead characterized by means of μ-Raman (632.8 nm laser) [see ***Appendix A4.1.***].

♦ **Results**

<table>
<tr><th colspan="2">Cobalt violet (arsenate) [$Co_3(AsO_4)_2$]</th></tr>
<tr><td>FTIR

</td>
<td>μ-EDXRF: Co, As

FTIR: 869 cm^{-1}, s | υ_{as}(As-O)

Corbeil, M.C.; Charland, J.P.; Moffatt, E.A. "The Characterization of Cobalt Violet Pigments." Studies in Conservation, 47 (2002): 237-49.</td></tr>
<tr><th colspan="2">Cobalt violet (phosphate) [$Co_3(PO_4)_2$]</th></tr>
<tr><td>FTIR

</td>
<td>μ-EDXRF: Co, (Ca, Fe, Zn)

FTIR:
3452 cm^{-1}, s,br | remaining H_2O
1632 cm^{-1}, m | remaining H_2O (υ(OH))
1041 cm^{-1}, vs | $\upsilon_{as}(PO_4^{3-})$
810, weak and 692 cm^{-1}, m | Co-O
513 cm^{-1}, vw | $\delta(PO_4^{3-})$
452 cm^{-1}, s,sh |υ(P-O)

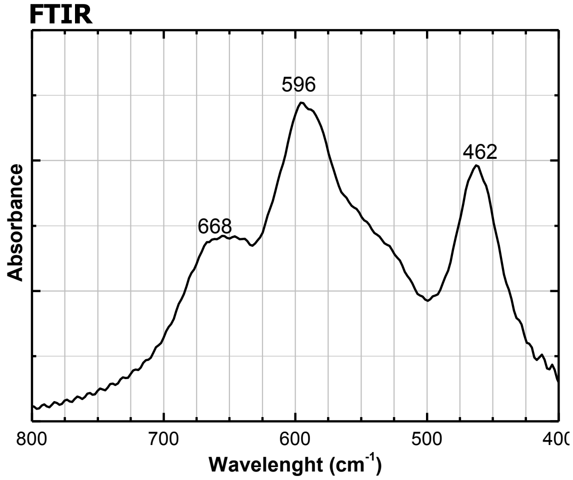
Corbeil, M.C.; Charland, J.P.; Moffatt, E.A. "The Characterization of Cobalt Violet Pigments." Studies in Conservation, 47 (2002): 237-49.

Zhou, G.; Wang, W.; Gu, G.; Li, Y. "Microwave assisted synthesis of Cobalt Phosphate nanoparticles and their antiproliferation against human lung cancer and primary osteoblasts in vitro." International Journal of Chemistry, 3 (4): 127-33.

Casadio, F.; Bezúr, A.; Fiedler, I.; Muir, K.; Trad T.; Maccagnola, S. "Pablo Picasso to Jasper Johns: a Raman study of cobalt-based synthetic inorganic pigments." Journal of Raman Spectroscopy, 43 (2012): 1761-71.</td></tr>
</table>

Cerulean blue [$CoO \bullet nSnO_2$]

FTIR



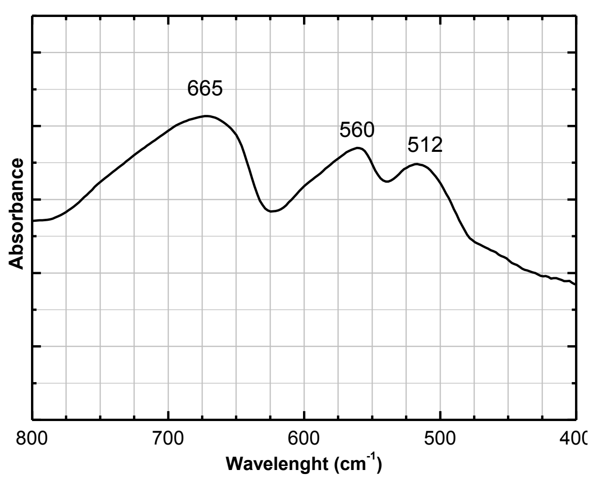
μ-EDXRF: Co, Sn, Ba, Zn

FTIR:
668 cm^{-1}
596 cm^{-1}
462 cm^{-1}

Silva, C.E.; Silva, L.P.; Edwards, H.G.M; Oliveira, L.F.C. "Diffuse reflection FTIR spectral database of dyes and pigments." *Analytical and Bioanalytical Chemistry, 386* (2006):2183–91.

Cobalt blue [$CoO \bullet Al_2O_3$]

FTIR



μ-EDXRF: Co, Ba, Zn

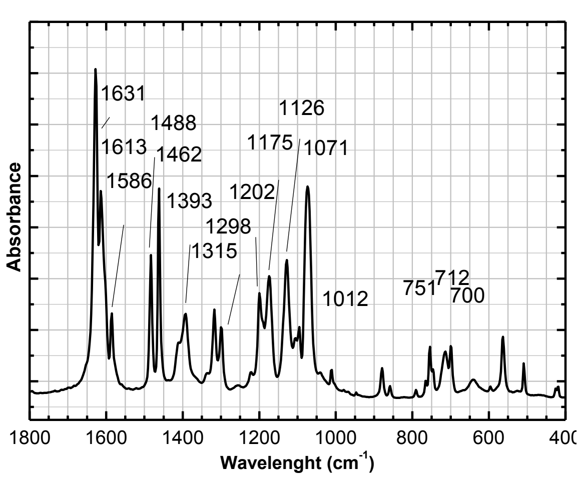
FTIR:
665 cm^{-1} | tetrahedral CoO_4
560 cm^{-1} | octahedral AlO_6
512 cm^{-1}

Learner, T. *Analysis of Modern Paints.* Los Angeles: The Getty Conservation Institute, 2004.

Jonynaite, D.;Jasaitis, D.; Raudonis, R.; Selskis, A.; Juskenas, R.; Senvaitiene, J.; Kareiva, A. "Sol-gel synthesis and study of neodymium substitution effects in Co-Al-Nd-O system with possible applications as novel inorganic pigments." *Central European Journal of Chemistry, 10* (2012): 1574-83.

Indigo ($C_{16}H_{10}N_2O_2$)

FTIR



μ-EDXRF: --

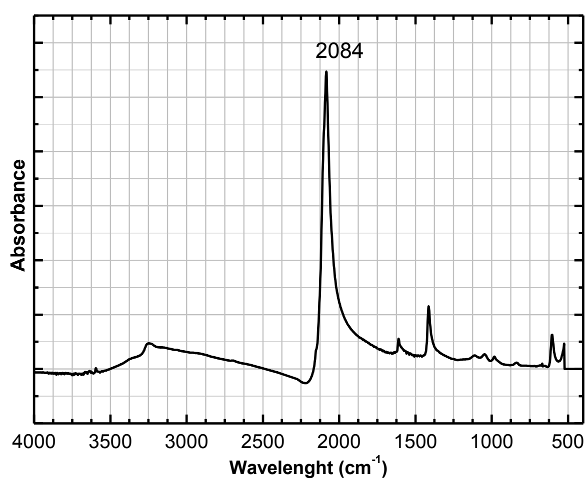
FTIR:

1631 cm^{-1}, s|$\upsilon_{C=C} + \upsilon_{C=O} + \beta_{ring5ip}$; $\upsilon_{C=O}$;
1613 cm^{-1}, s|$\upsilon_{C=C} + \upsilon_{C=O} + \beta_{ring5ip} + \beta_{ring6ip}$; $\upsilon_{CC\ ring6ip}$
1586 cm^{-1}, w|$\upsilon_{C=C} + \upsilon_{C=O}$; $\upsilon_{CC\ ring6ip}$;$\rho_{CHiph,\ asym} + \upsilon_{CCring6}$;1488m|$\rho_{CHiph,\ sym} + \upsilon_{CCring6}$; $\rho_{CHoph,\ sym} + \upsilon_{CCring6}$; 1462s| $\rho_{CHoph,\ asym} + \upsilon_{CCring6}$;1393m|$\rho_{NH} + \upsilon_{CN}$; 1315m|$\rho_{NH} + \upsilon_{CN} + \rho_{CHiph,\ aym}$; $\upsilon_{CCring6} + \upsilon_{CCring5} + \rho_{CHoph,asym}$; 1298m| $\rho_{CHiph,\ sym} + \beta_{R5ip}$; $\rho_{CHiph,\ asym} + \upsilon_{CN} + \upsilon_{CCring6} + \upsilon_{CCring5;}\rho_{NH} + \upsilon_{CN} + \upsilon_{C=C}$;1202w| $\upsilon_{CCring5} + \rho_{CHoph,\ asym} + \beta_{ring6ip}$; 1175s|$\upsilon_{CN} + \rho_{CHoph,asym} + \rho_{NH}$; 1126m| $\rho_{NH+}\upsilon_{CN}$; 1071s|$\upsilon_{CCring5} + \rho_{CO}$; $\upsilon_{CCring6\ breath,\ sym}$; 1012m| $\upsilon_{CCring6\ breath,\ asym}$; 751m|$\omega_{CH} + \beta_{ring6op}$; 712m|$\beta_{ring6ip} + \beta_{ring5ip}$; 700m|$\beta_{ring5op} + \beta_{ring6op} + \omega_{CO}$; $\beta_{ring6ip} + \rho_{CO} + \rho_{C=C}$

Baran, A.; Fielder, A.; Schulz, H.; Baranska, M. "*In situ* Raman and IR spectroscopic analysis of indigo dye." *Analytical Methods, 2* (2010): 1372-76.

Prussian blue [$Fe_4[Fe(CN)_6]_3 \bullet 14H_2O$ or $KFe[Fe(CN)_6 \bullet H_2O]$]

FTIR



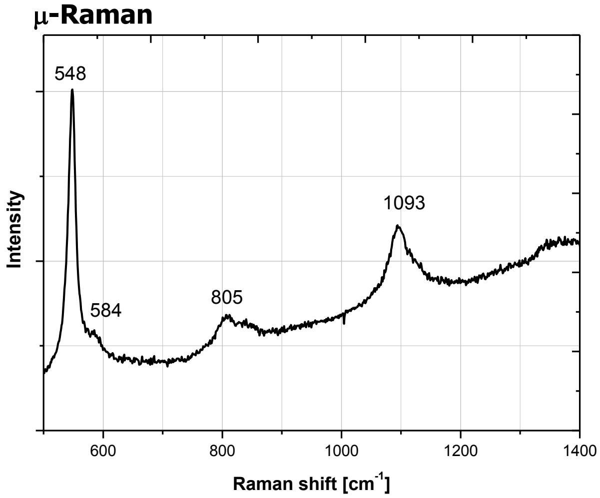
μ-EDXRF: Fe

FTIR: 2084 cm^{-1}, s | υ(C≡N)

Silva, C.E.; Silva, L.P.; Edwards, H.G.M; Oliveira, L.F.C. "Diffuse reflection FTIR spectral database of dyes and pigments." *Analytical and Bioanalytical Chemistry, 386* (2006):2183–91.

Ultramarine blue [$Na_{8-10}(Al_6Si_6O_{24})S_{2-4}$]

μ-Raman



μ-EDXRF: S, Al, K

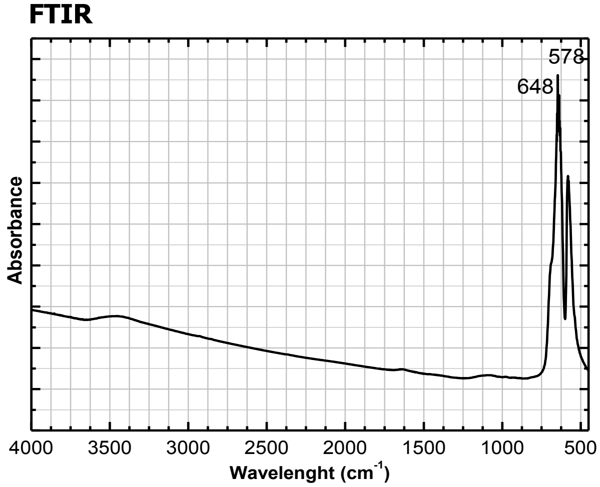
μ-Raman:
548 cm^{-1}|υ($S^{3-)}$
584 cm^{-1}|υ(S^{3-} and S^{2-})
805 cm^{-1}|υ(S^{3-})
1093 cm^{-1}|υ(S^{3-})

Desnica, V.; Furic, K.; Schreiner, M. "Multianalytical characterisation of a variety of ultramarine pigments." *e-Preservation Science, 1* (2004): 15-21.

Rosi, F.; Miliani, C.; Borgia, I.; Brunetti, B.; Sgamellotti, A. "Identification of nineteenth century blue and green pigments by *in situ* x-ray fluorescence and micro-Raman spectroscopy." *Journal of Raman Spectroscopy, 35* (2004): 610-15.

Chrome oxide green (Cr_2O_3)

FTIR



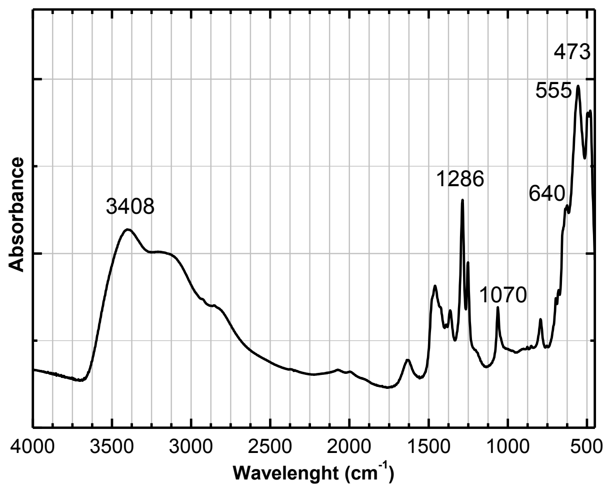
μ-EDXRF: Cr

FTIR:
678 cm^{-1}, sh | υ (Cr-O)
578 cm^{-1}, sh | υ (Cr-O)

Vahur, S.; Teearu, A.; Leito, I. "ATR-FTIR spectroscopy in the region 550-230 cm^{-1} for identification of inorganic pigments." *Spectrochimica Acta Part A, 75* (2010): 1061–72.

Viridian ($Cr_2O_3 \bullet 2H_2O$)

FTIR



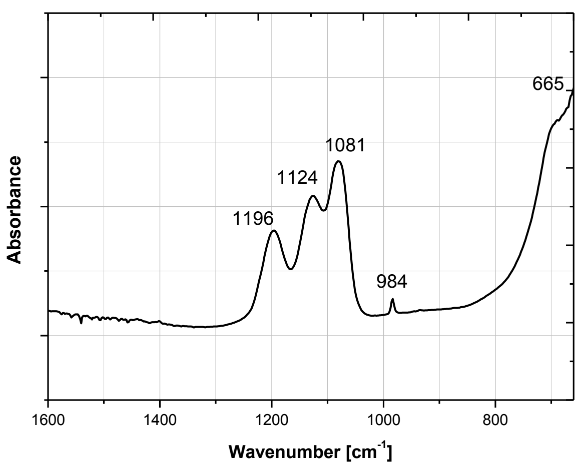
μ-EDXRF: Cr (Ca, Fe)

FTIR: 3630-2630 cm^{-1}, very broad | υ (OH)
1286 cm^{-1}, m
1070 cm^{-1}, s
640 cm^{-1}, s| γ (OH)
555 cm^{-1}, sh
473 cm^{-1}, sh

Kendix, E.L.; Prati, S.; Mazzeo, R.; Joseph, E.; Sciutto, G.; Fagnano, C. "Far Infrared Spectroscopy in the field of Cultural Heritage." *e-Preservation Science, 7* (2010): 8-13.

Cobalt green (CoO•nZnO)

FTIR



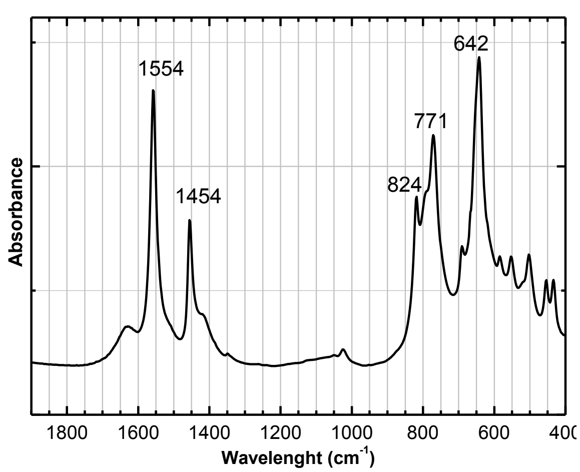
μ-EDXRF: Co, Zn

FTIR:
665 cm^{-1} | υ (Co-O)

Gražėnaitė, A.; Kiuberis, J. ; Beganskienė, A. ; Senvaitienė, J.; Kareiva, A. " XRD and FTIR characterisation of historical green pigments and their lead-based glazes." *Chemija, 25* (4) (2014): 199-205.

Schweinfurt green [$Cu(C_2H_3O_2)_2 \bullet 3Cu(AsO_2)_2$]

FTIR



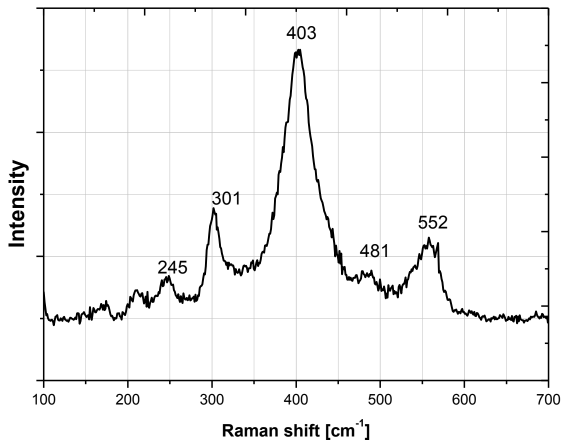
μ-EDXRF: Cu, As

FTIR: 1554 cm^{-1}, strong| carboxylate
1455 cm^{-1}, w| carboxylate
824 cm^{-1}, m| As-O
771 cm^{-1}, m| As-O
642 cm^{-1}, s| As-O

Fielder, I. and Bayard, M.A., "Emerald Green and Scheele's Green." In *Artists' Pigments. A Handbook of Their History and Characteristics* (Volume 3), edited by E. West FitzHugh, 219-70. Oxford: Oxford University Press, 1997.

Yellow ochre (α-FeOOH)

μ-Raman



μ-EDXRF: Fe

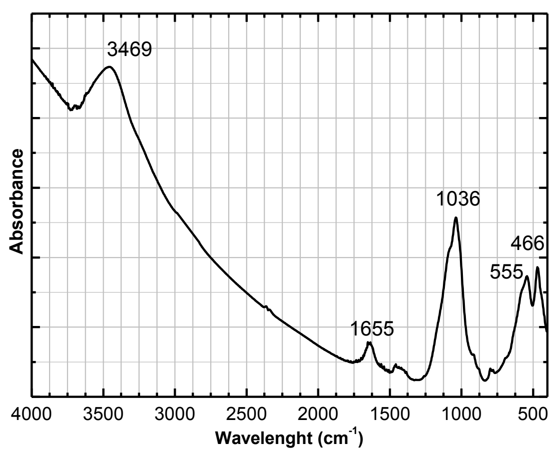
μ-Raman:

245 cm^{-1}, m; 301 cm^{-1} m; 403 cm^{-1}, s; 481 cm^{-1}, w and 552 cm^{-1}, m| goethite [α-FeO(OH)]

Montagner, C.; Sanches, D.; Pedroso, J.; Melo, M.J.; Vilarigues, M. "Ochres and earths: matrix and chromophores characterisation of 19th and 20th century artist materials." *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 103* (2013): 409-16.

Burnt Sienna

FTIR



μ-EDXRF: Fe, (K, Ca)

FTIR:

3469 cm^{-1}, very broad | υ (OH) (from iron oxide/hydroxide)

1655 cm^{-1}, sharp | $\delta(H_2O)$

1036 cm^{-1}, strong | υ_{as} (Si-O-Si) (from quartz (SiO_2))

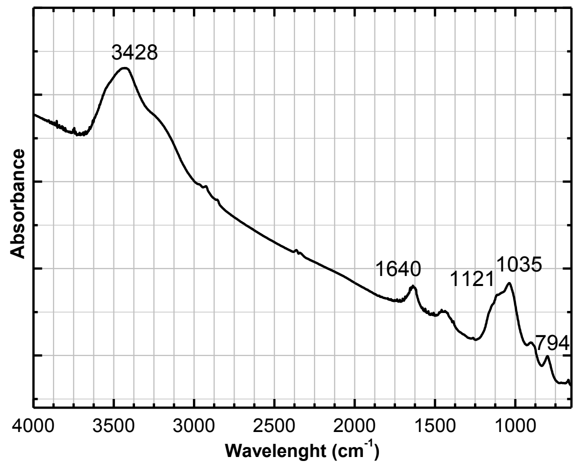
555 and 466 cm^{-1} | Ferric oxide (Fe_2O_3)

Bikiaris, D.; Daniilia, S.; Sotiropoulou, S. , Katsimbiri, O; Pavlidou, E. , Moutsatsou, A.P. , Chryssoulakis, Y. "Ochre-differentiation through micro-Raman and micro-FTIR spectroscopies: application on wall paintings at Meteora and Mount Athos, Greece." *Spectrochimica Acta Part A, 56* (1999): 3–18.

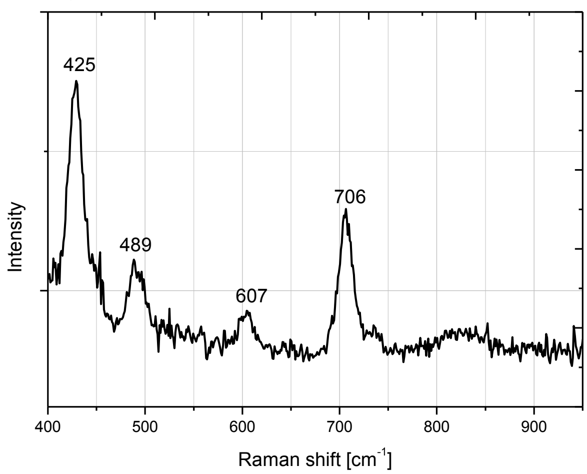
Montagner, C.; Sanches, D.; Pedroso, J.; Melo, M.J.; Vilarigues, M. "Ochres and earths: matrix and chromophores characterisation of 19th and 20th century artist materials." *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 103* (2013): 409-16.

Raw Sienna

FTIR



μ-Raman



μ-EDXRF: Fe, (Ca)

FTIR:
3428 cm^{-1}, v br | υ (OH) (from iron oxide/hydroxide)
1640 cm^{-1}, sh | δ(H_2O)
1121 cm^{-1}, shoulder | $υ_{anti-sy}$(Si-O-Si) (from quartz (SiO_2))
1035 cm^{-1}, s | $υ_{as}$ (Si-O-Si) (from quartz (SiO_2))
794 cm^{-1}, w | υ (Si-O) (from quartz (SiO_2))

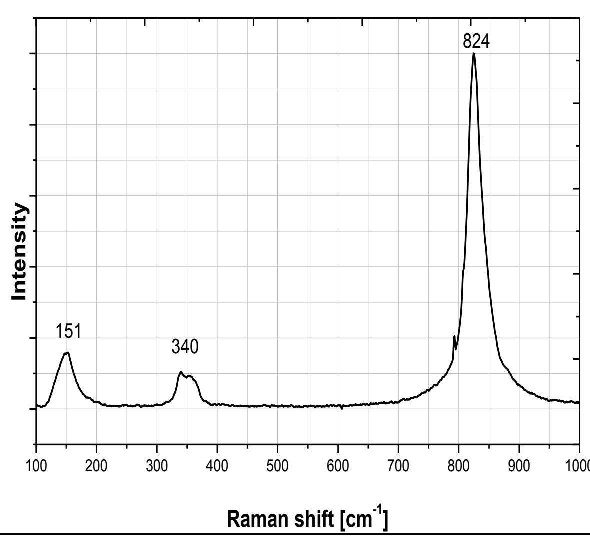
μ-Raman:

425 cm^{-1}, s | goethite [(α-FeO(OH)]
489 cm^{-1}, s | hematite (Fe_2O_3)
607 cm^{-1}, m | goethite [(α-FeO(OH)]
706 cm^{-1}, s

Montagner, C.; Sanches, D.; Pedroso, J.; Melo, M.J.; Vilarigues, M. "Ochres and earths: matrix and chromophores characterisation of 19th and 20th century artist materials." *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy, 103* (2013): 409-16.

Chrome yellow ($PbCrO_4$)

μ-Raman



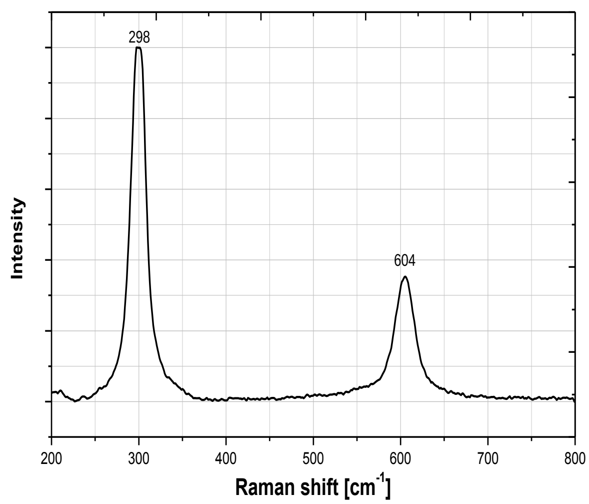
μ-EDXRF: Pb, Cr

μ-Raman:
824 cm^{-1}, s| υ(CrO_4^{2-})
325-399 cm^{-1}, m| δ(CrO_4^{2-})

Otero, V.; Pinto, J.V.; Vilarigues, M.; Cotte, M.; Melo, M.J. "Nineteenth century chrome yellow and chrome deep from Winsor & Newton™." *Studies in Conservation* (2016): 1-27.

Cadmium yellow (CdS)

μ-Raman



μ-EDXRF: Cd, Zn, Ba, S

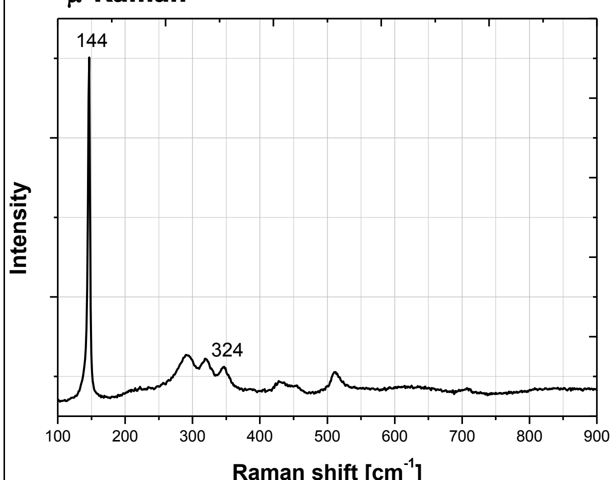
μ-Raman:
298 cm^{-1} | LO-phonon frequency
604 cm^{-1}| overtone 2LO of the CdS crystal

Correia, A.M.; Clark, R.J.H.; Ribeiro, M.I.M.; Duarte, M.L.T.S. "Pigment study by Raman microscopy of 23 paintings by the Portuguese artist Henrique Pousão (1859-1884)." *Journal of Raman Spectroscopy, 38* (2007): 1390-1405.

Aguayo, T.; Clavijo, E.; Villagrán, A.; Espinosa, F.; Sangüés, F.E.; Campos-Vallette, M. "Raman vibrational study of pigments with patrimonial interest for the Chilean cultural heritage." *Journal of the Chilean Chemical Study, 55* (3) (2010): 347-51.

Naples yellow ($Pb_2Sb_2O_7$)

μ-Raman



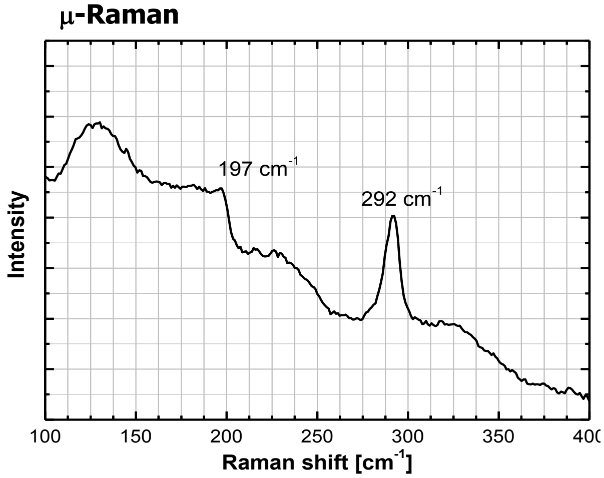
μ-EDXRF: Pb, Sb, Ti

μ-Raman:
144 cm^{-1}, s| υ(Pb-O)
324 cm^{-1}, m

Kock, L.D. and De Waal, D. "Raman analysis of ancient pigments on a tile from the Citadel of Algiers." *Spectrochimica Acta A: Molecular and Biomolecular Spectroscopy, 71* (4) (2008): 1348-54.

Cadmium red [Cd(S,Se)]

μ-Raman



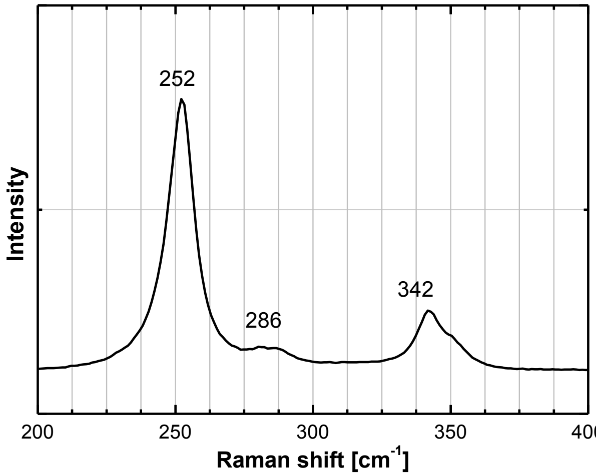
μ-EDXRF: Cd, (Zn), Se

μ-Raman:
197 cm^{-1} | LO-phonon frequency (CdSe)
292 cm^{-1} | LO-phonon frequency (CdS)

Prinsloo, L.C.; Boeyens, J.C.A.; Van der Ryst, M.M.; Webb, G. "Raman signatures of the modern pigment (Zn, Cd)$S_{1-x}Se_x$ and glass matrix of a red bead from Magoro Hill, an archaeological site in Limpopo Province, South Africa, recalibrate the settlement chronology." *Journal of Molecular Structure, 1023* (2012): 123-27.

Vermilion (HgS)

μ-Raman



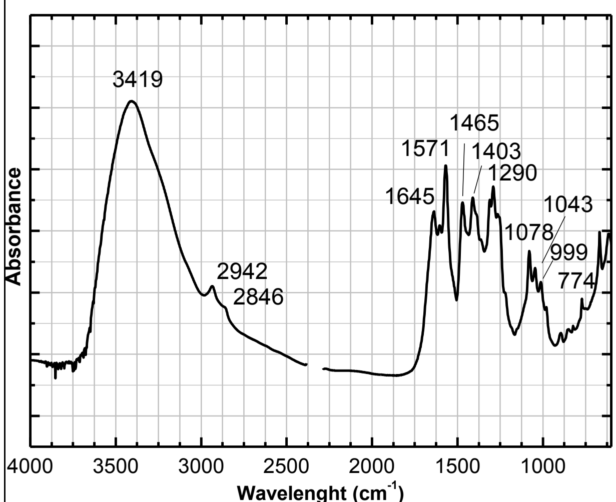
μ-EDXRF: Hg

μ-Raman: 252 cm^{-1}| υ(Hg-S)
286 cm^{-1}
342 cm^{-1}

Abdel-Ghani, M. "Dating a Coptic icon of anonymous painter by spectroscopic study of pigment palette." *Mediterranean Archeology and Archaeometry, 15* (2015): 23-37.

Carmine

FTIR



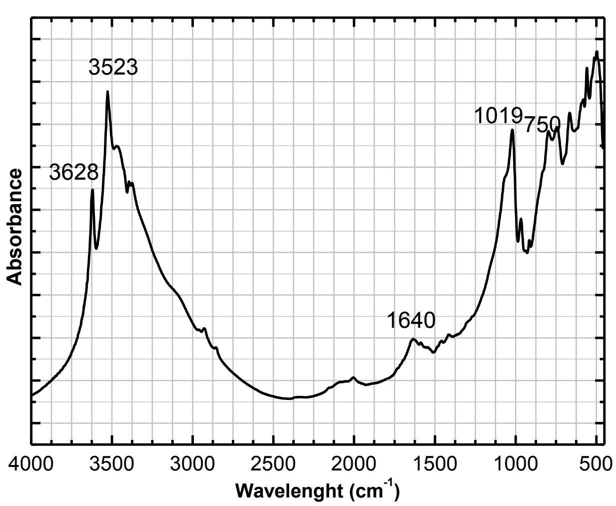
μ-EDXRF: Ca, Ba, Fe, Zn

FTIR:
3419 cm^{-1}, s|υ(OH)
2942; 2846 cm^{-1} w|υ (CC)
1645 cm^{-1}, m; 1571 cm^{-1}, s|υ (CC)/δ(COH)/δ(OH)
1465 cm^{-1}, s|υ (CC)/δ(CH_3)/δ(OH)
1403 cm^{-1}, m; 1290 cm^{-1}, sh|υ (CC)
1078 cm^{-1}, s|υ (CC)
1043 cm^{-1}, s|δ(COH)
999 cm^{-1}, w|ρ(CH_3)
774 cm^{-1}, w|γ(COH)

Rosu. M.C.; Suciu, R.C.; Mihet, M.; Bratu, I. "Physical–chemical characterization of titanium dioxide layers sensitized with the natural dyes carmine and morin." *Materials Science in Semiconductor Processing*, *16* (2013) 1551–57.

Rose madder (Alizarin)

FTIR



μ-EDXRF: Ca, Fe, Cu, Zn

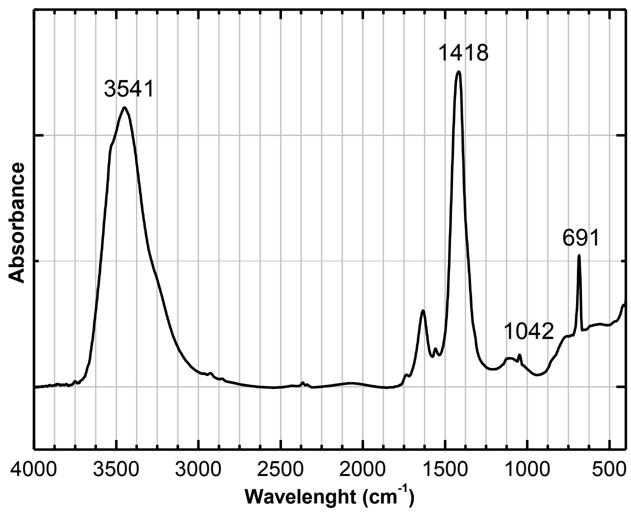
FTIR:
1640 cm^{-1} s|υ(CO_3^{2-})
1587 cm^{-1} , weak|υ(aromatic ring)
1019 cm^{-1}, m|δ-H-aromatic ring
750 cm^{-1} w|υ-H-aromatic ring

Bicchieri, M. "The purple *Codex Rossanensis*: spectroscopic characterization and first evidence of the use of the elderberry lake in a 6th century manuscript." (2014) [online version consulted: https://arxiv.org/ftp/arxiv/papers/1404/1404.6414.pdf; Last accessed on February 11, 2017].

Daniels, V.; Devièse, T.; Hacke, M.; Higgitt, C. "Technological insights into madder pigment production in antiquity." *Technical bulletin. Vol 8* (2014), 13-28. London: The British Museum.

Lead white [$2PbCO_3 \bullet Pb(OH)_2$]

FTIR



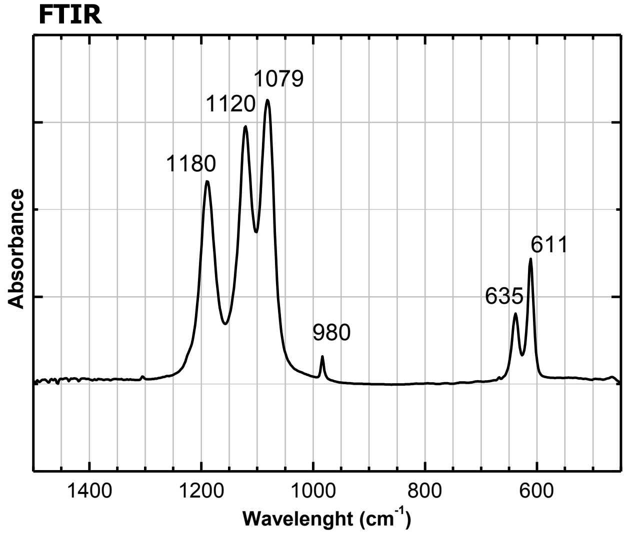
μ-EDXRF: Pb

FTIR:
3541 cm^{-1}, m | υ(OH)
1418 cm^{-1}, s; br | $\upsilon_{as}(CO_3^{2-})$
1042 cm^{-1}, w | δ(OH)
691 cm^{-1}, m | $\delta_{as}(CO_3^{2-})$

Centeno, S.A.; Guzman, M.I.; Yamazakikleps, A.; Védova, C.O.D. "Characterization by FTIR of the Effect of Lead White on Some Properties of Proteinaceous Binding Media." *Journal of the American Institute for Conservation, 43* (2004):139-150.

Barium sulphate ($BaSO_4$)

FTIR



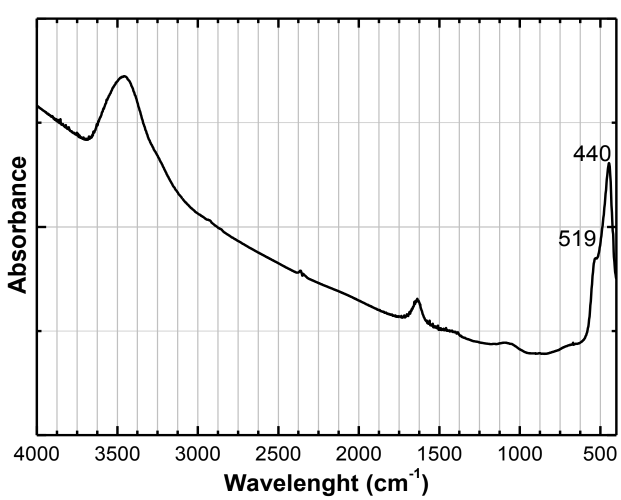
μ-EDXRF: Ba, Zn, Pb

FTIR:
1200-1050 cm^{-1}, s; br|$\upsilon_{as}(SO_4)$
980 cm^{-1}, w | $\upsilon_{as}(SO_4)$
635 cm^{-1}
611 cm^{-1}

Humel, D.O. *Atlas of Plastics Additives - Analysis by Spectrometric Methods*. Verlag-Berlin-Heidelberg-New York: Springer, 2002.

Zinc white (ZnO)

FTIR



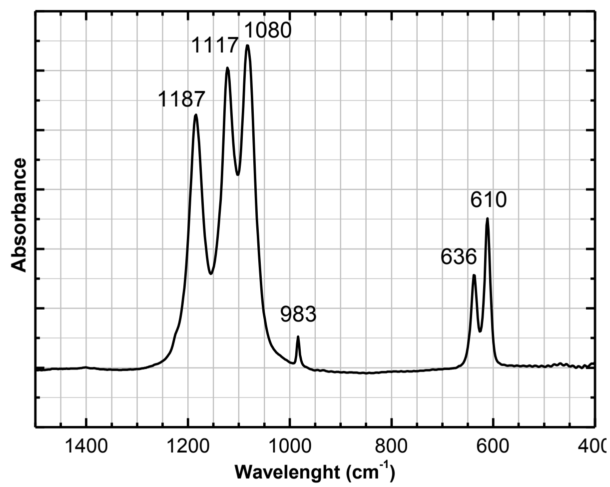
μ-EDXRF: Zn

FTIR:
519 and 440 cm^{-1} | TO-phonon frequency and LO-phonon frequency

Anžlovar, A.; Orel, Z.C.; Kogej, K.; Zigon, M. "Polyol-Mediated Synthesis of Zinc Oxide Nanorods." *Journal of Nanomaterials* (2012): 1-9.

Lithopone (ZnS+ $BaSO_4$)

FTIR



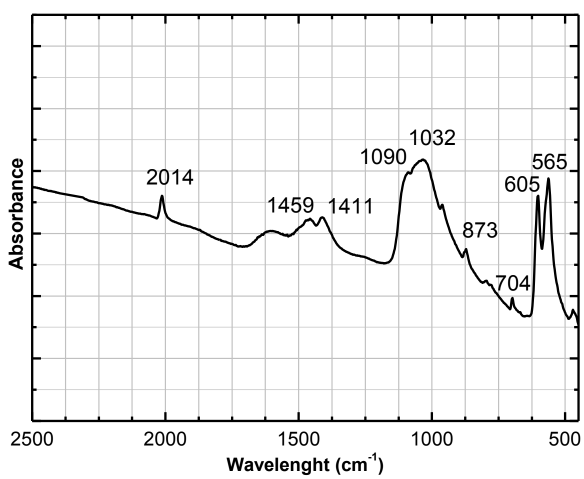
μ-EDXRF: Ba, Zn

FTIR: $BaSO_4$:
1200-1050 cm^{-1}, s;br|$\upsilon_{as}(SO_4)$
980 cm^{-1}, weak|$\upsilon_{as}(SO_4)$636
610 cm^{-1}

Humel, D.O. *Atlas of Plastics Additives - Analysis by Spectrometric Methods*. Verlag-Berlin-Heidelberg-New York: Springer, 2002.

Ivory black [C+$Ca_3(PO_4)_2$]

FTIR



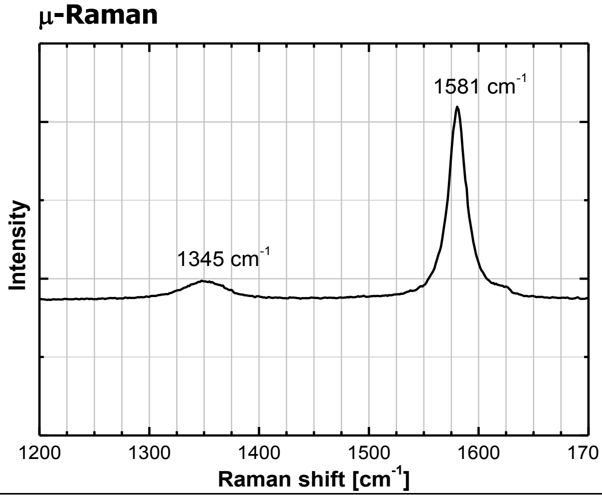
μ-EDXRF: Ca, Fe

FTIR:
2014 cm^{-1}, sh | isocyanate, thiocyanate and isothyocianate groups (from degradation of proteins)
1459 cm^{-1}, m; 1411 cm^{-1}, m and 873 cm^{-1}, w| hydroxyapatite
1090 cm^{-1}, shoulder; 1032 cm^{-1}, s|
υ_{as} (PO_4)
605 and 565 cm^{-1}, sh | (PO_4)

Tomasini, E; Siracusano, G.; Maier, M.S. "Spectroscopic, morphological and chemical characterization of historic pigments based on carbon. Paths for the identification of an artistic pigment." *Microchemical Journal, 102* (2012): 28–37.

Graphite (C)

μ-Raman



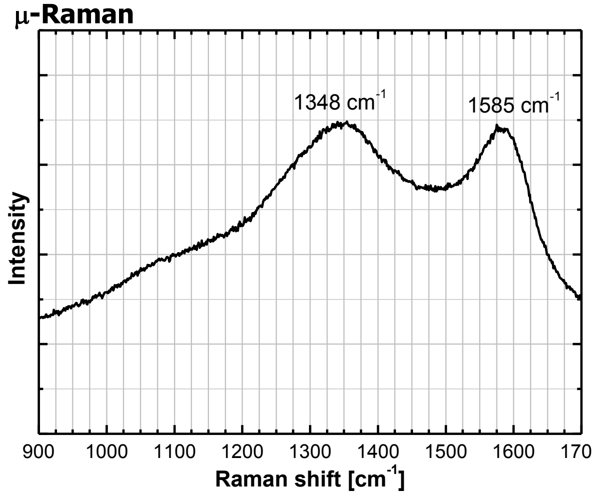
μ-EDXRF: --

μ-Raman:
1581cm^{-1}
1345 cm^{-1}

Chu, P.K. and Li, L. "Characterization of amorphous and nanocrystalline carbon films." *Materials Chemistry and Physics, 96* (2006): 253–277.

<table>
<tr><th colspan="2">Vine black (C)</th></tr>
<tr><td>

μ-Raman



</td><td>

μ-EDXRF: --

μ-Raman:
1585cm^{-1}
1348 cm^{-1}

Chu, P.K. and Li, L. "Characterization of amorphous and nanocrystalline carbon films." *Materials Chemistry and Physics, 96* (2006): 253–277.

</td></tr>
</table>

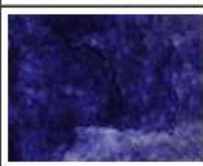
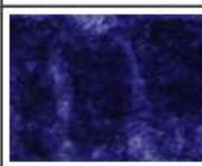
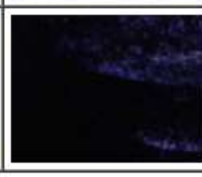
Note: υ – stretching; υ_{as} – asymmetrical stretching; δ – bending; γ – wagging; β – deformation modes; ω – wagging; ρ – rocking; breath – breathing vibrationss– strong; vs – very strong; m – medium; w– weak; br – broad; vbr – very broad; sh – sharpe; ring 5 – a 5 –membered ring of the indigo molecule; ring 6 – a 6 –membered ring of the indigo molecule; ip– in plane; op– out of plane; iph – in phase; oph – out of phase; sym – symmetric ; asym– asymmetric; anti-sy– anti-symmetric.

A6.3. – Paint layers

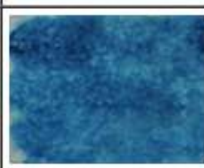
Cobalt violet (arsenate)

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Cobalt violet (phosphate)

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

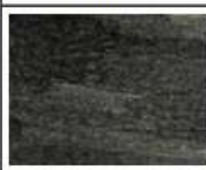
Cerulean blue

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Cobalt blue

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

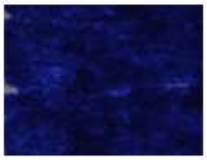
Indigo

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

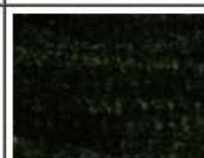
Prussian blue

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

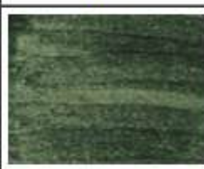
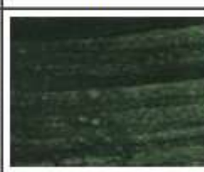
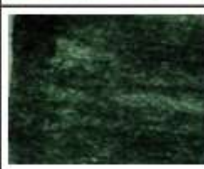
Ultramarine blue, synthetic

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

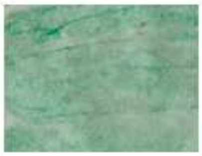
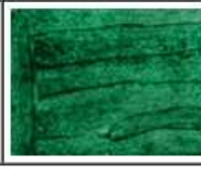
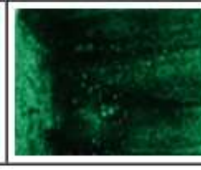
Chrome oxide green

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

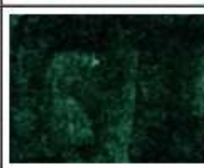
Cobalt green

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

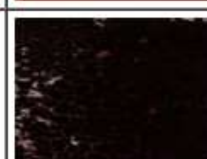
Schweinfurt green

	Photo				
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Viridian

	Photo				
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

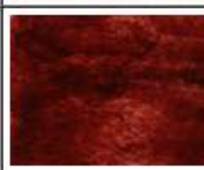
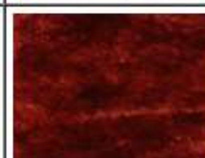
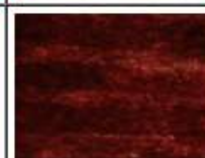
Carmine

	Photo				
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

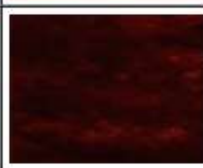
Rose madder

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

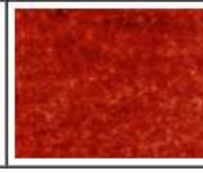
Vermilion

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Cadmium red

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Cadmium orange deep

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Cadmium orange light

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

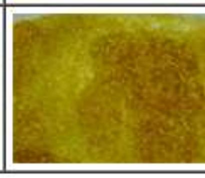
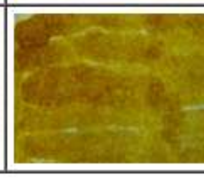
Cadmium yellow

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

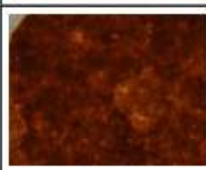
Chrome yellow

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Naples yellow

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Yellow ochre

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

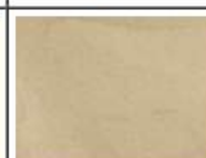
Raw Siena

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Burnt Siena

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Lead white

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

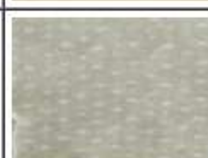
Zinc white

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Barium sulphate

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Lithopone

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Graphite

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Ivory black

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

Vine black

Photo					
Method	**5%**	**10%**	**20%**	**30%**	**40%**
Normal					
Transparency					

A6.4. – Reflectance Spectra [FORS Zeiss 0º/ 2x45° and DRS Lambda1050]

- Cobalt violet (arsenate)

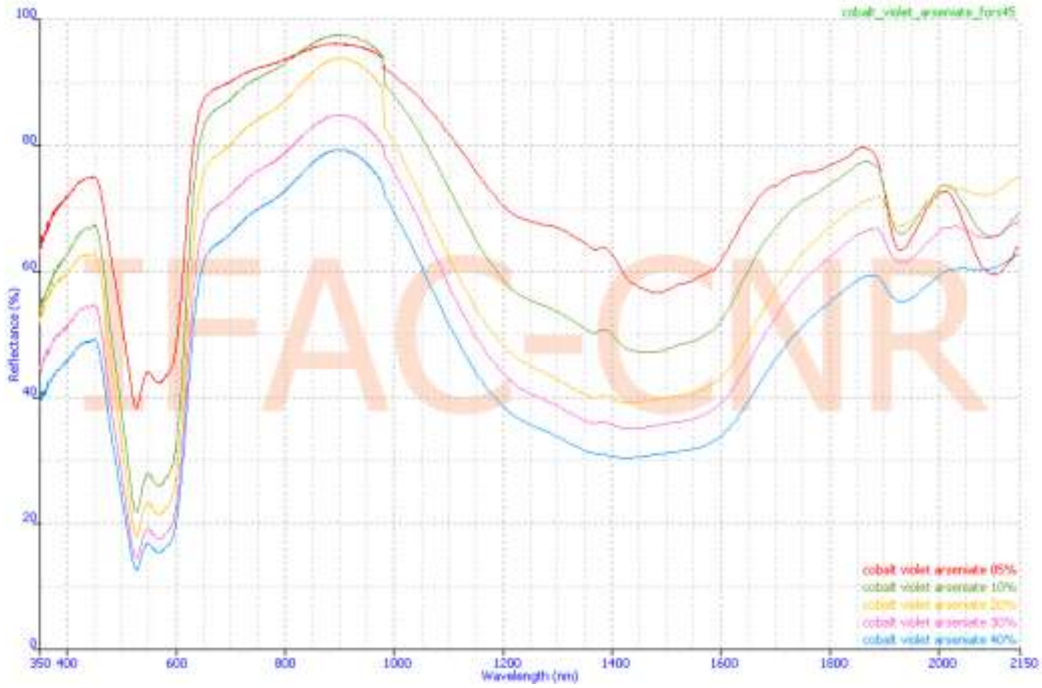


Figure VI.4.1. Reflectance spectra of cobalt violet (arsenate) watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

Figure VI.4.2. Reflectance spectra of cobalt violet (arsenate) watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Cobalt violet (phosphate)

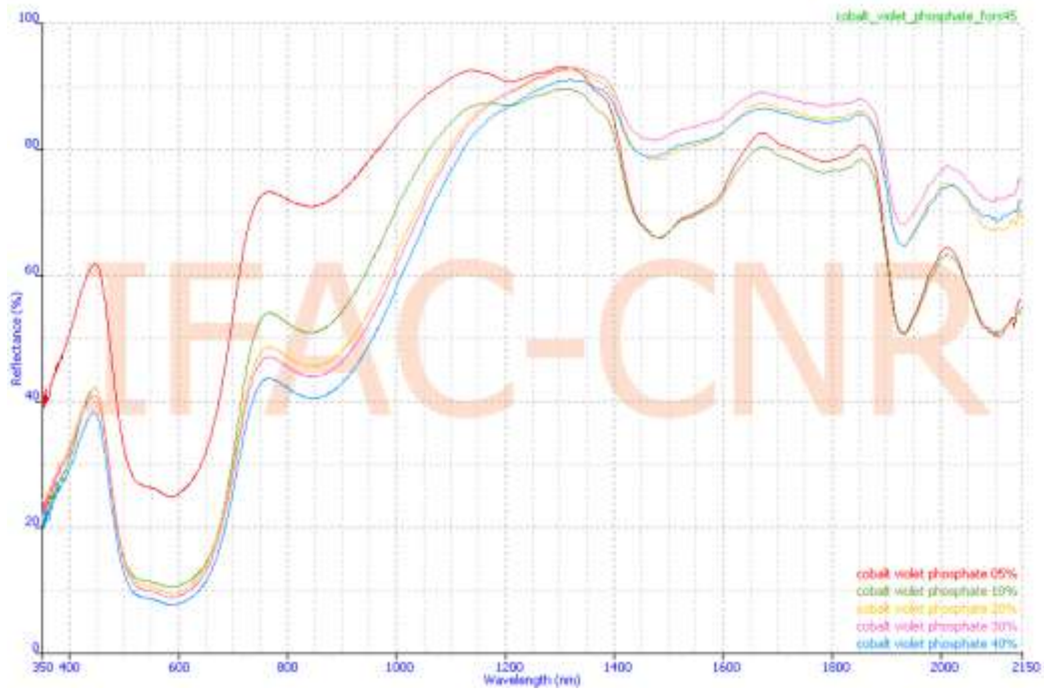


Figure VI.4.3. Reflectance spectra of cobalt violet (phosphate) watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

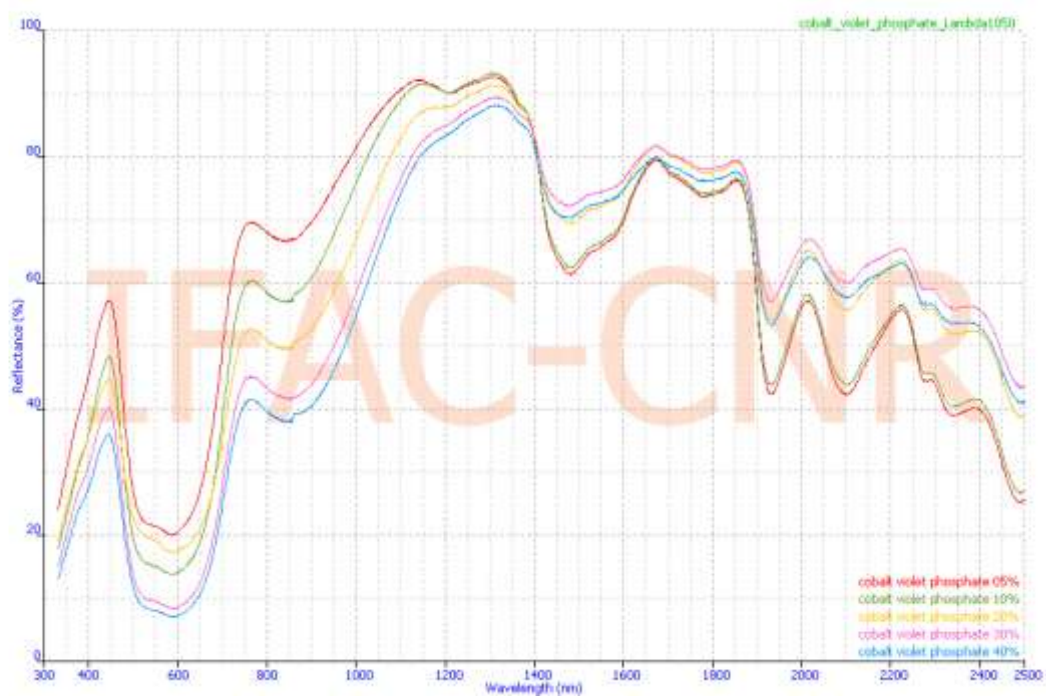


Figure VI.4.4. Reflectance spectra of cobalt violet (phosphate) watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Cerulean blue

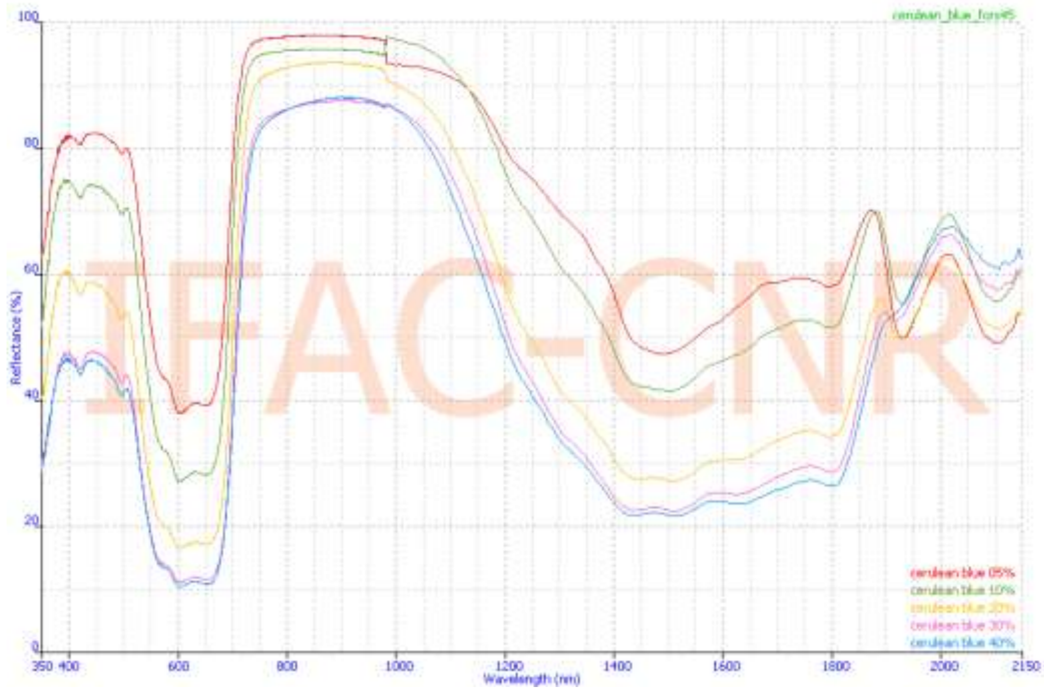


Figure VI.4.5. Reflectance spectra of cerulean blue watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

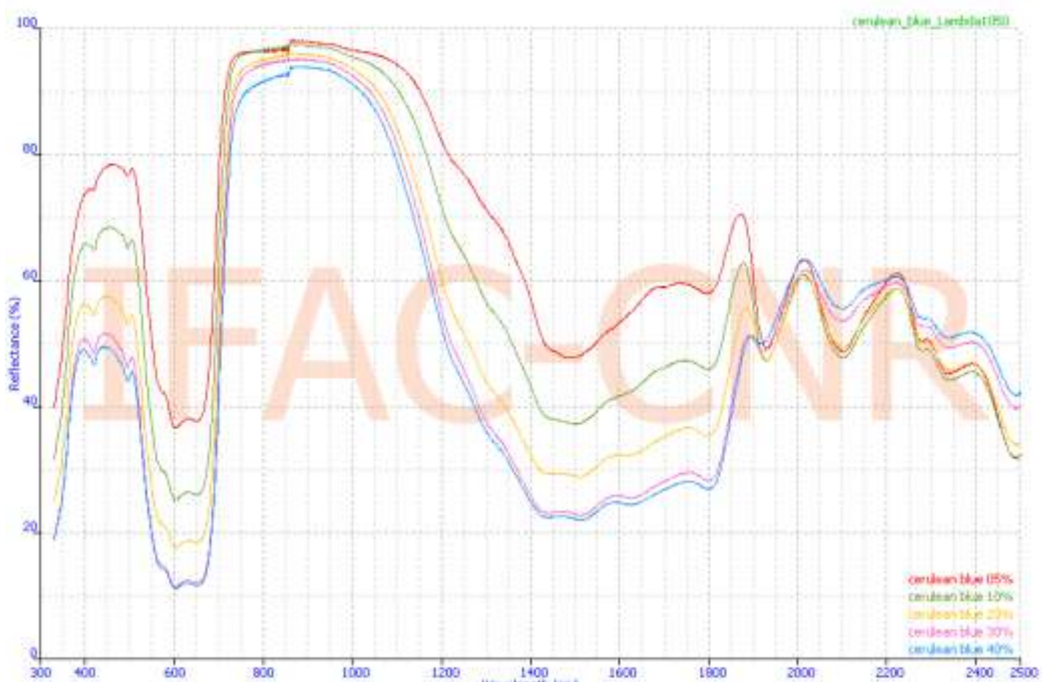


Figure VI.4.6. Reflectance spectra of cerulean blue watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Cobalt blue

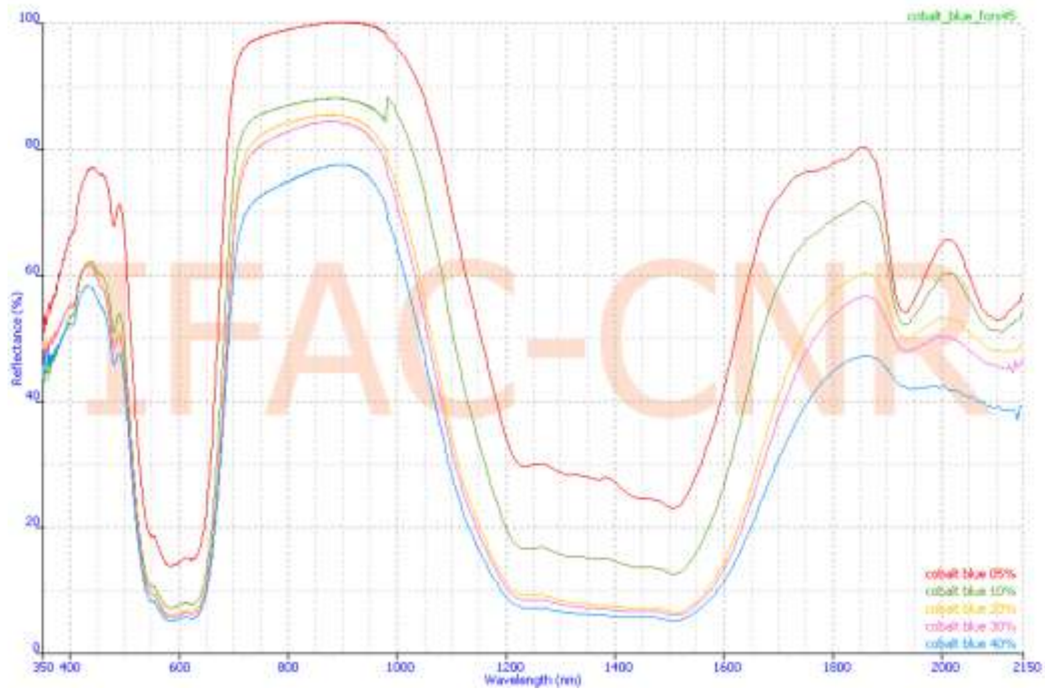


Figure VI.4.7. Reflectance spectra of cobalt blue watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

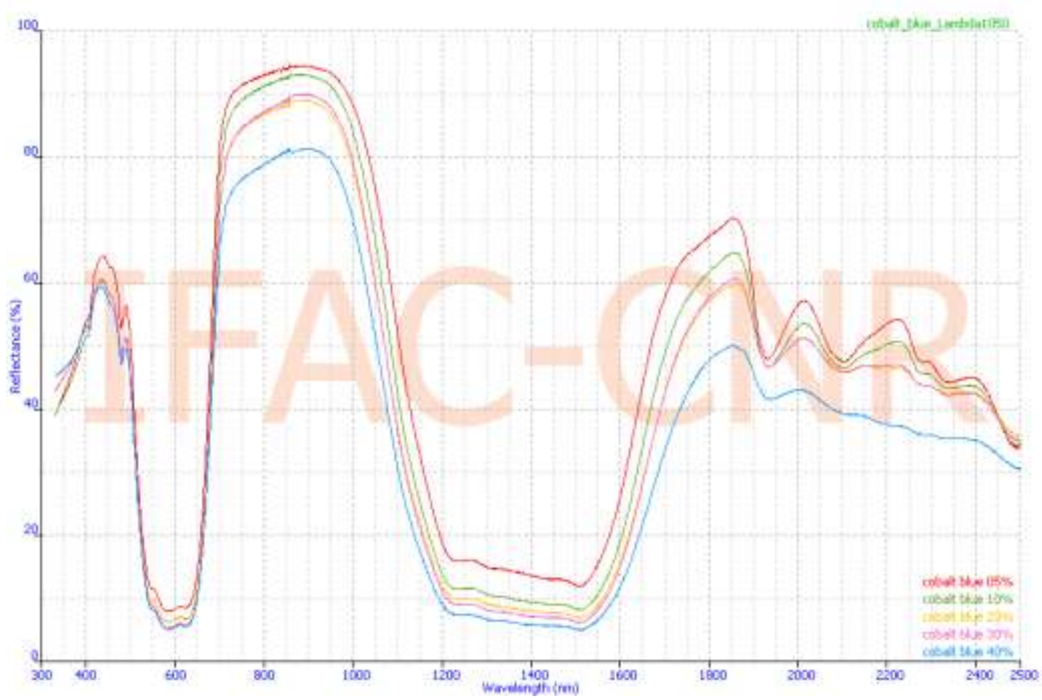


Figure VI.4.8. Reflectance spectra of cobalt blue watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Indigo

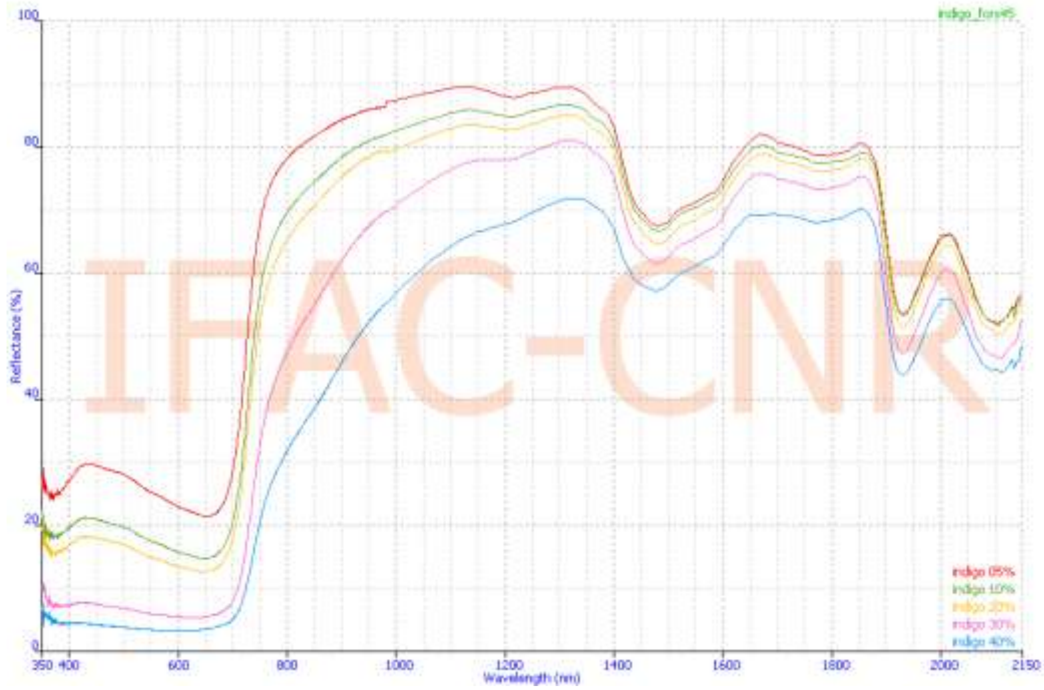


Figure VI.4.9. Reflectance spectra of indigo watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

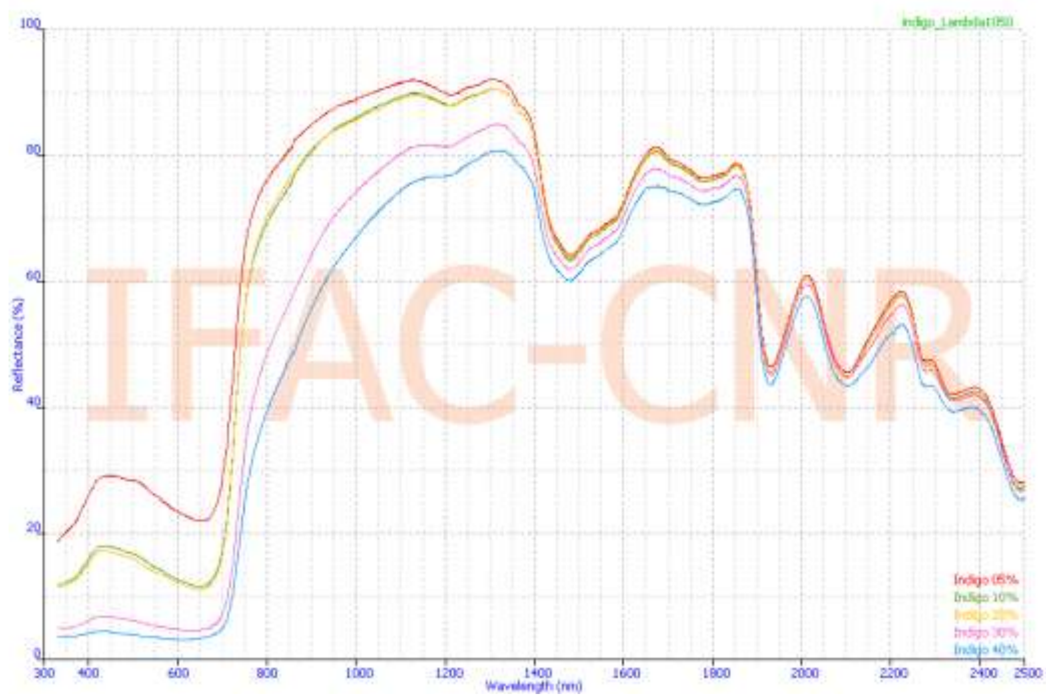


Figure VI.4.10. Reflectance spectra of indigo watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Prussian blue

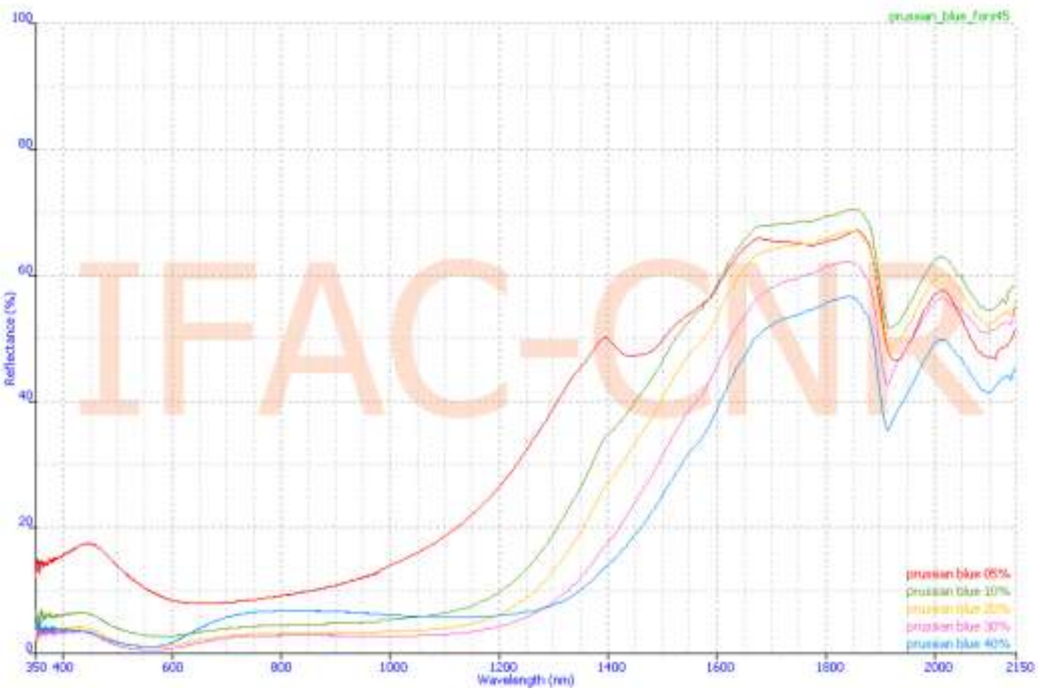


Figure VI.4.11. Reflectance spectra of Prussian blue watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

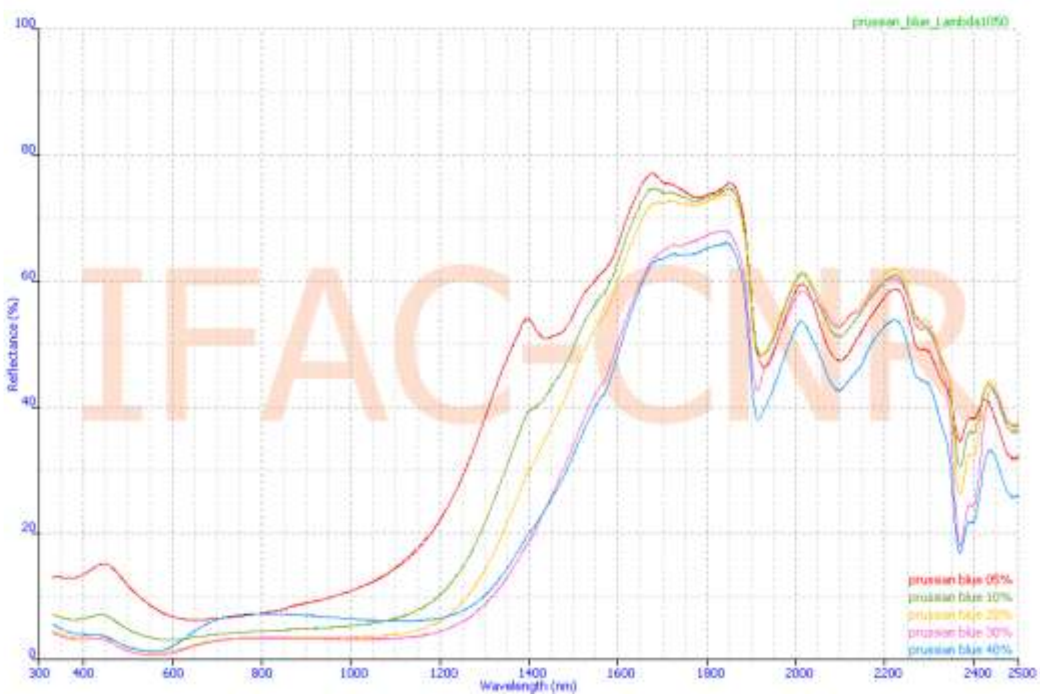


Figure VI.4.12. Reflectance spectra of Prussian blue watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Ultramarine blue, synthetic

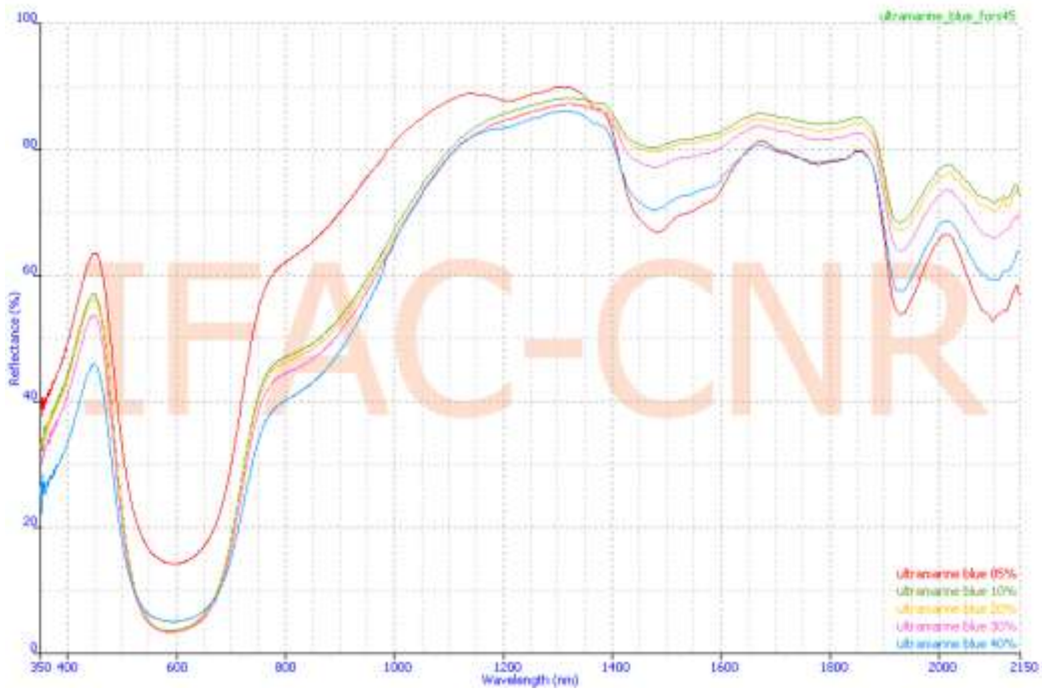


Figure VI.4.13. Reflectance spectra of Ultramarine blue watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

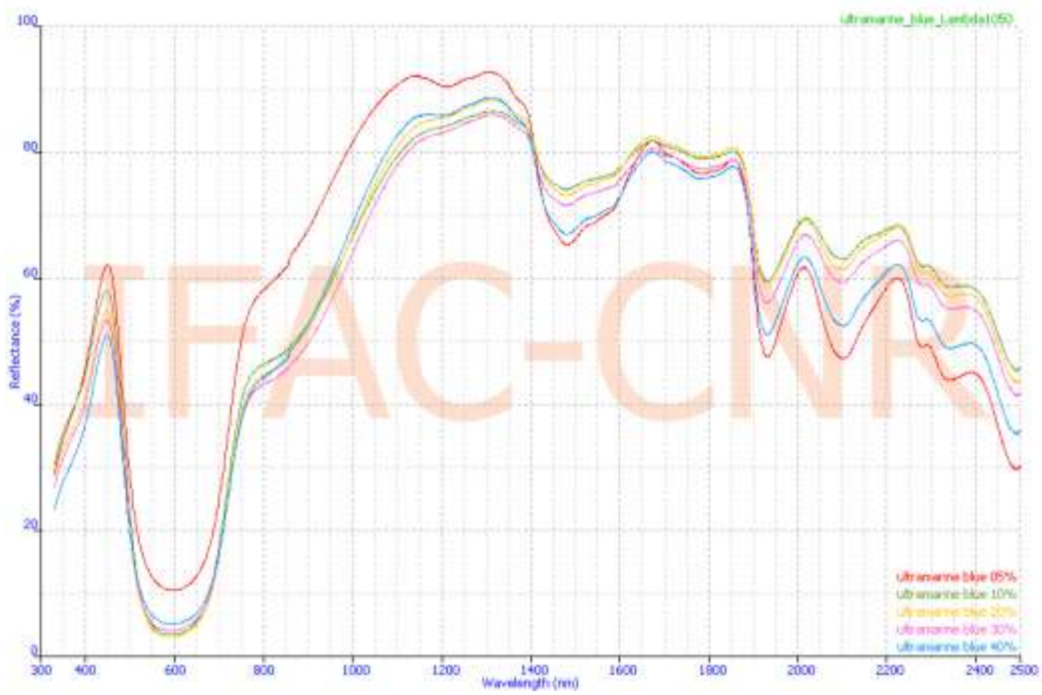


Figure VI.4.14. Reflectance spectra of Ultramarine blue watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Chrome oxide green

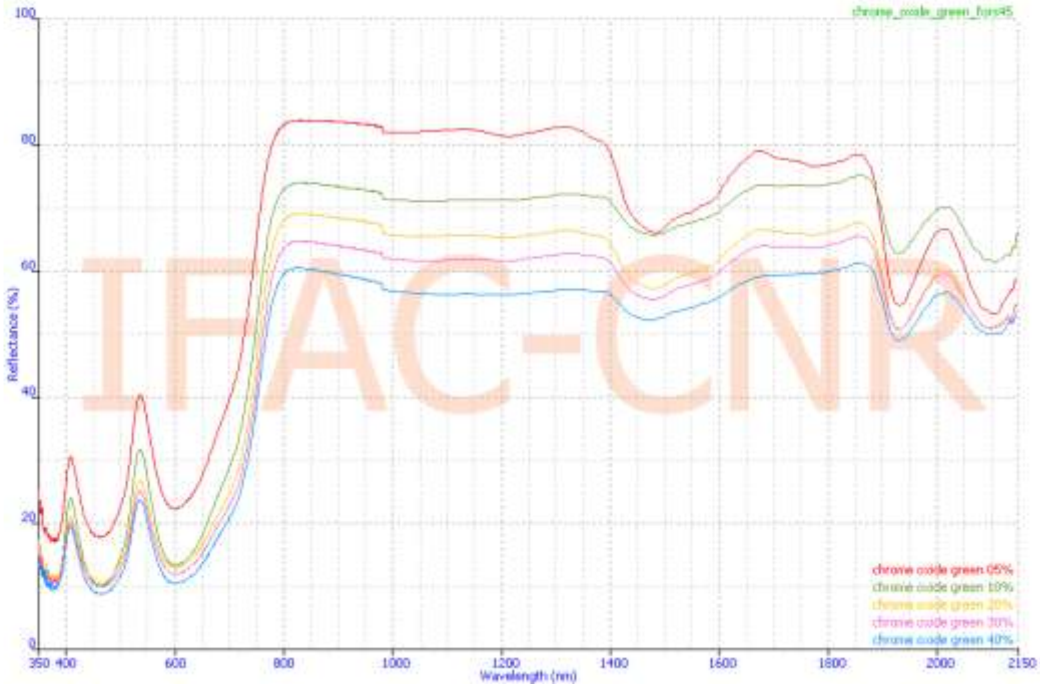


Figure VI.4.15. Reflectance spectra of Chrome oxide green watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

Figure VI.4.16. Reflectance spectra of Chrome oxide green watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Cobalt green

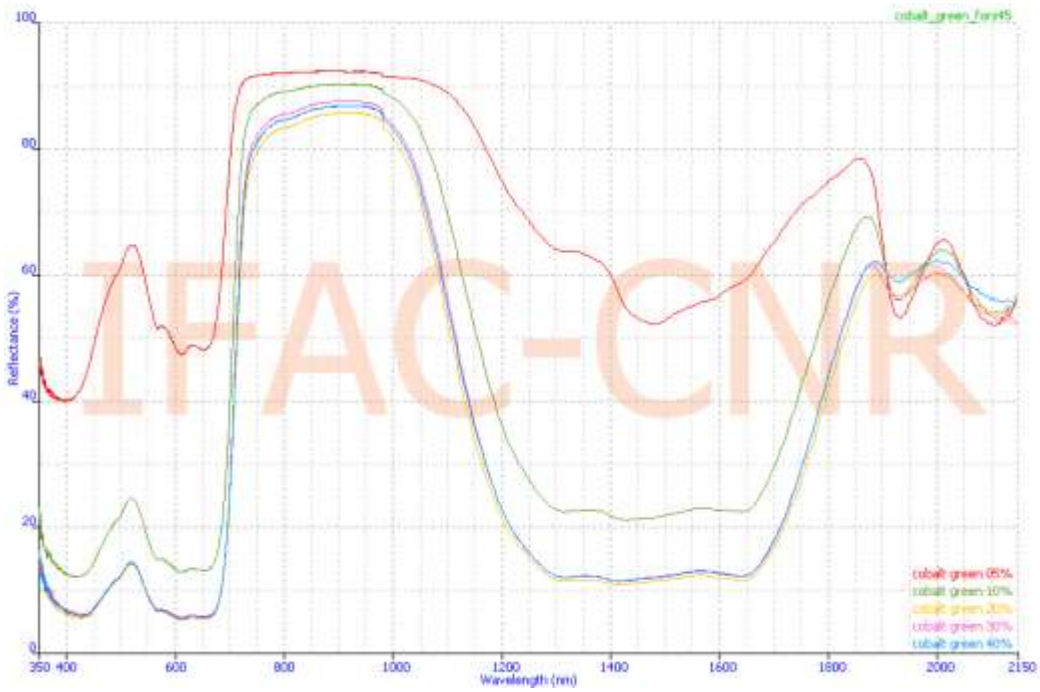


Figure VI.4.17. Reflectance spectra of Cobalt green watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

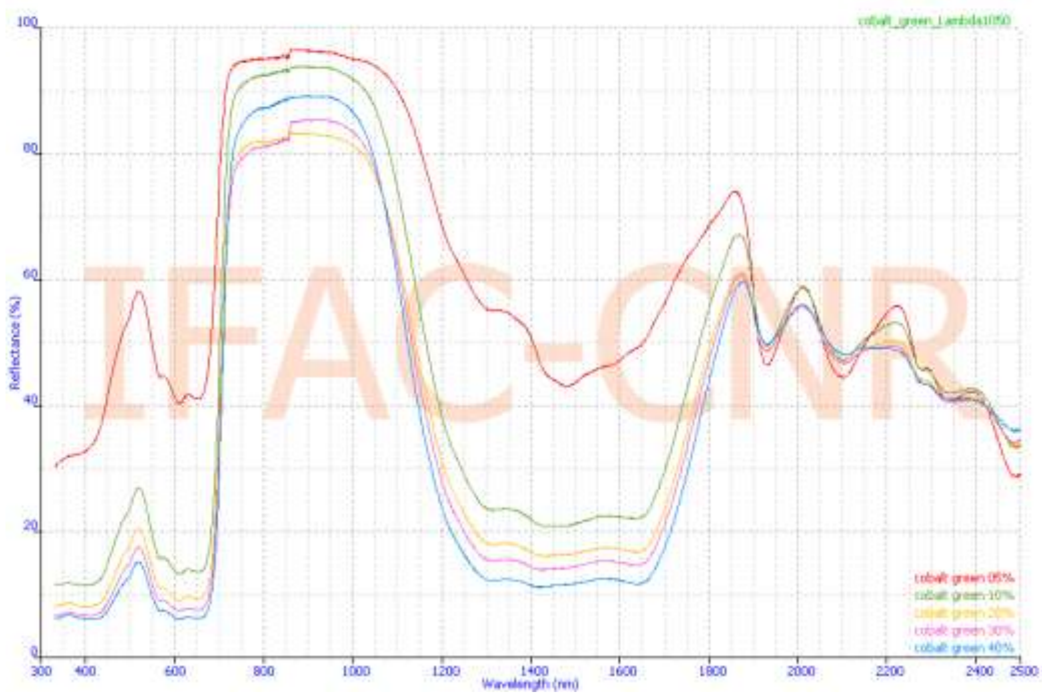


Figure VI.4.18. Reflectance spectra of Cobalt green watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Schweinfurt green

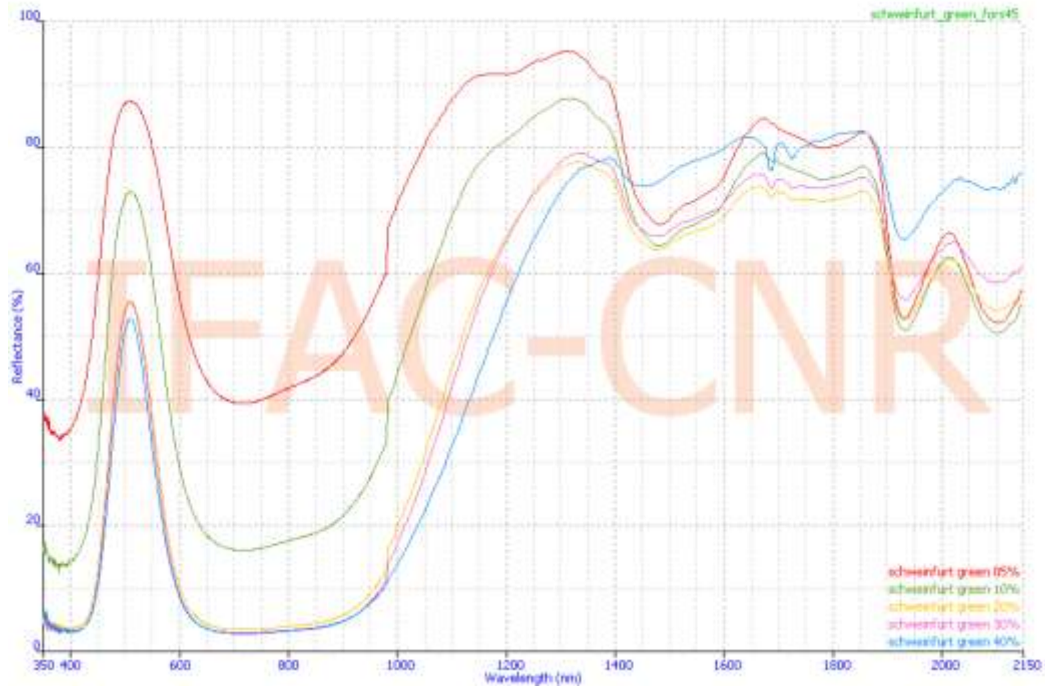


Figure VI.4.19. Reflectance spectra of Schweinfurt green watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

Figure VI.4.20. Reflectance spectra of Schweinfurt green watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Viridian

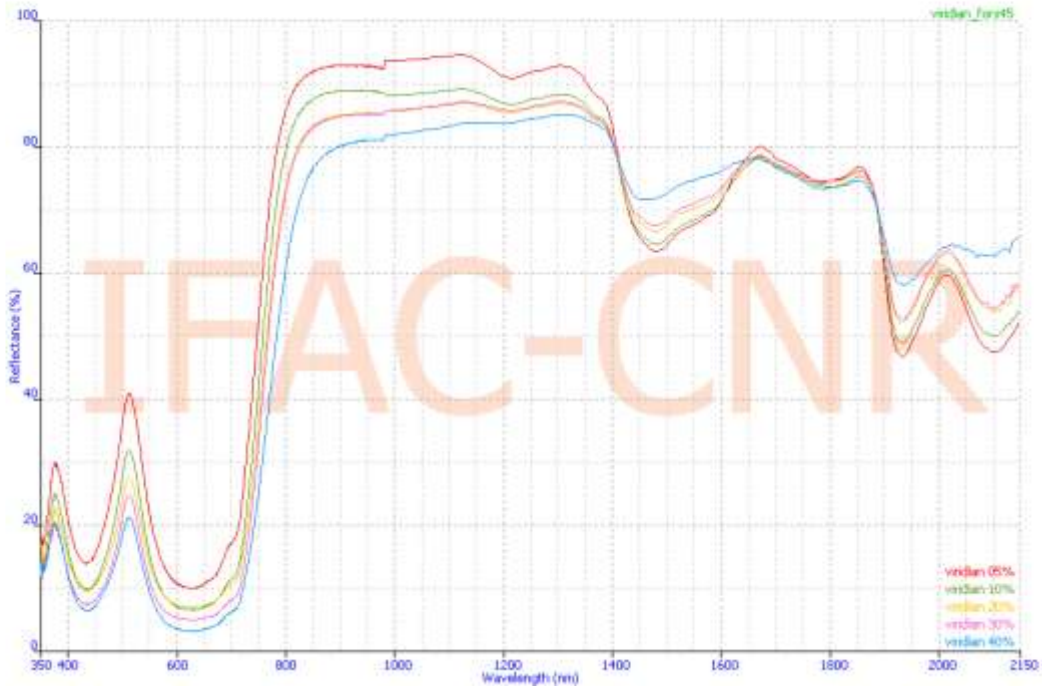


Figure VI.4.21. Reflectance spectra of Viridian watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

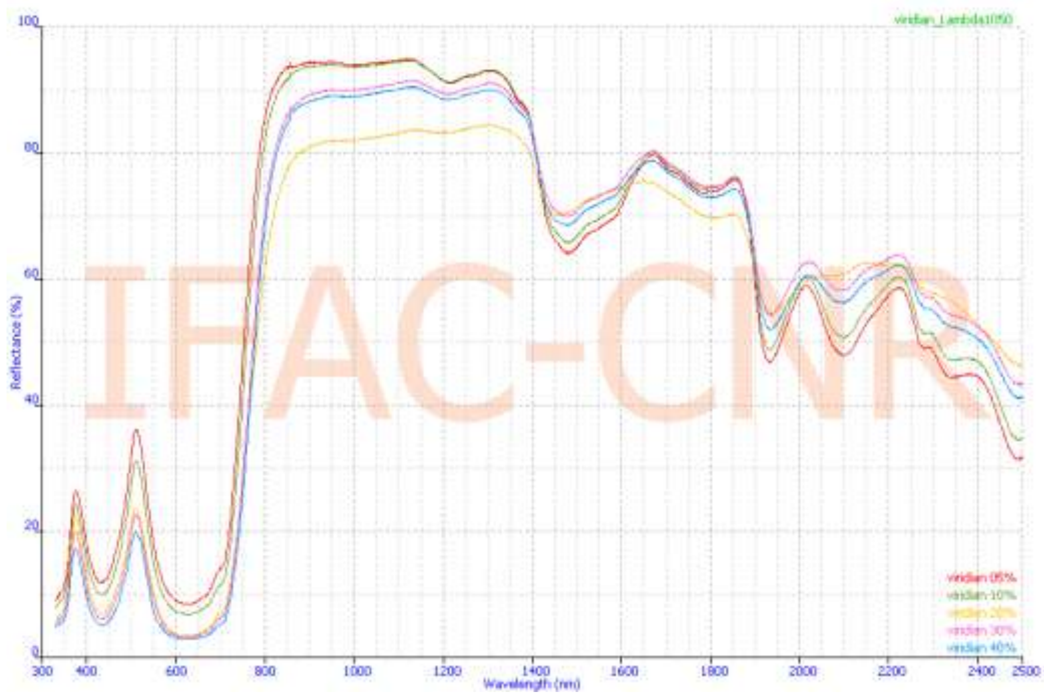


Figure VI.4.22. Reflectance spectra of Viridian watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Carmine

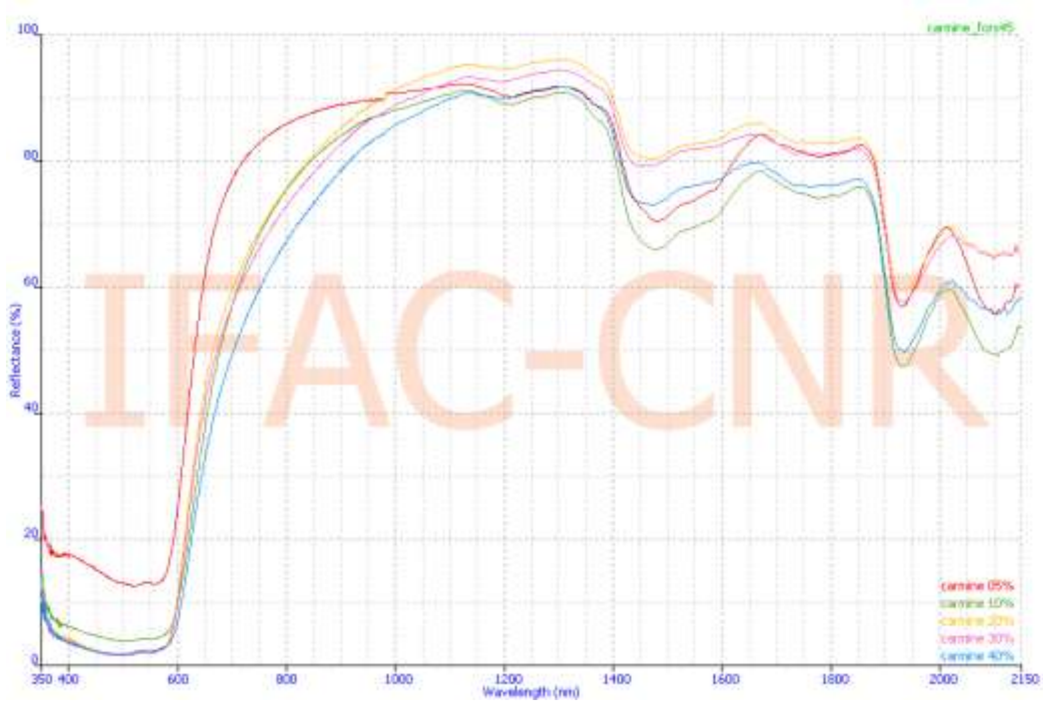


Figure VI.4.23. Reflectance spectra of Carmine watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

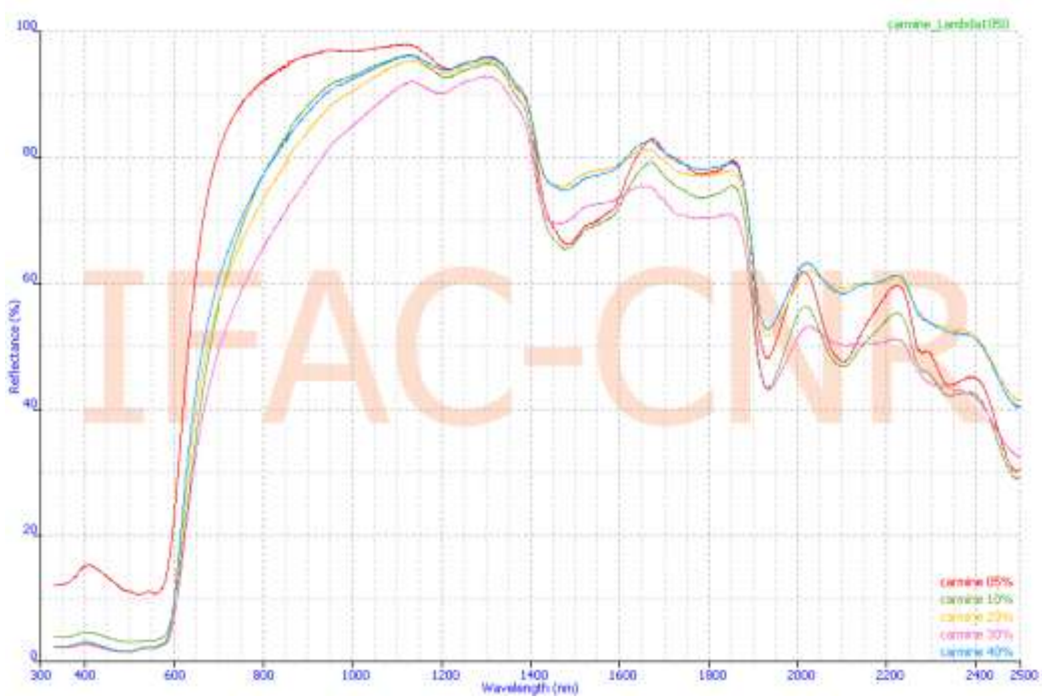


Figure VI.4.24. Reflectance spectra of Carmine watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Rose madder

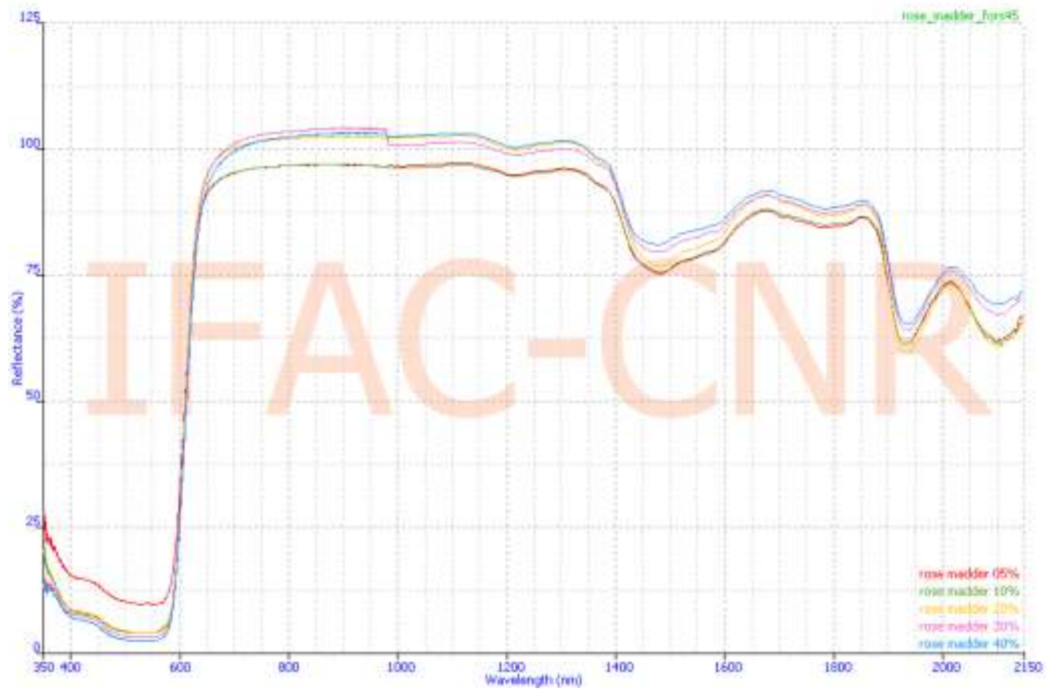


Figure VI.4.25. Reflectance spectra of Rose madder watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

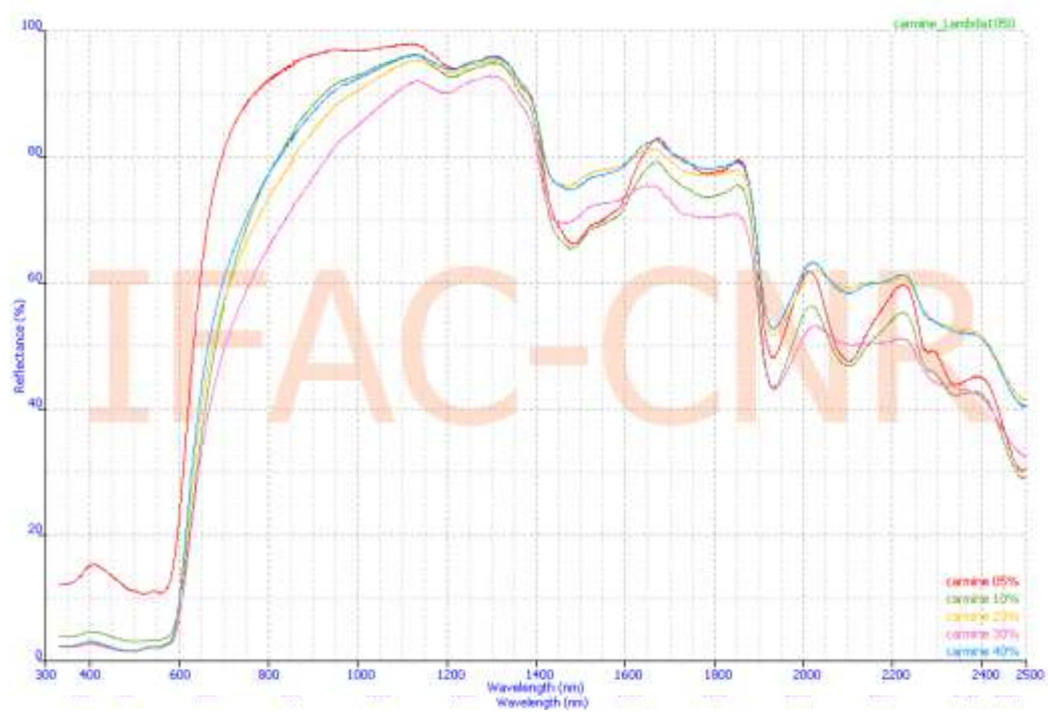


Figure VI.4.26. Reflectance spectra of Rose madder watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Vermilion

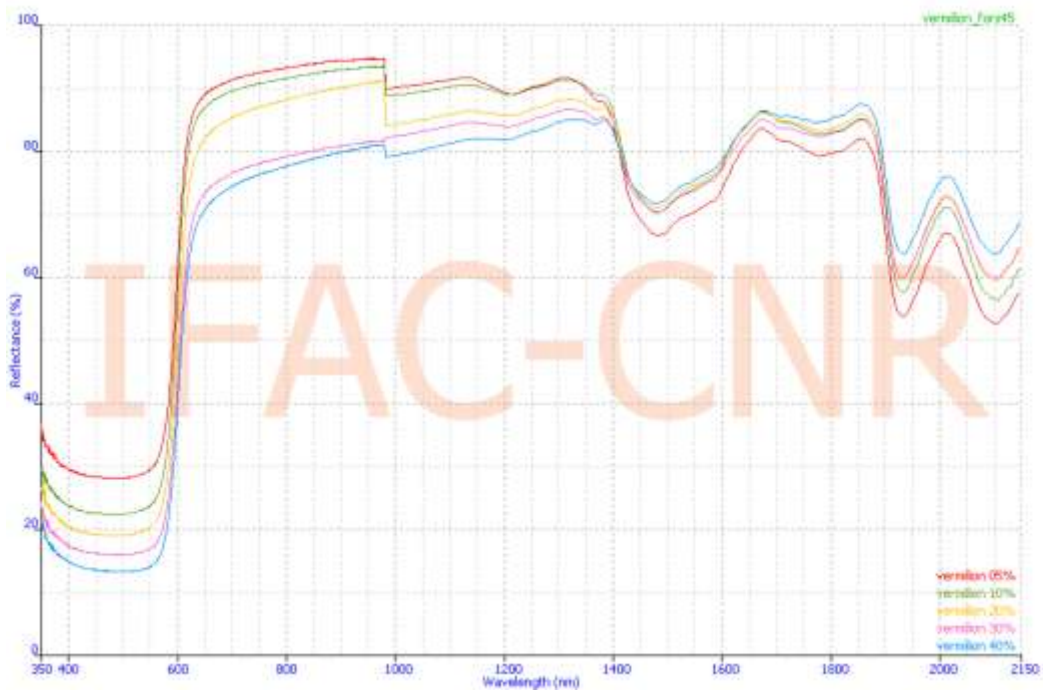


Figure VI.4.27. Reflectance spectra of Vermilion watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

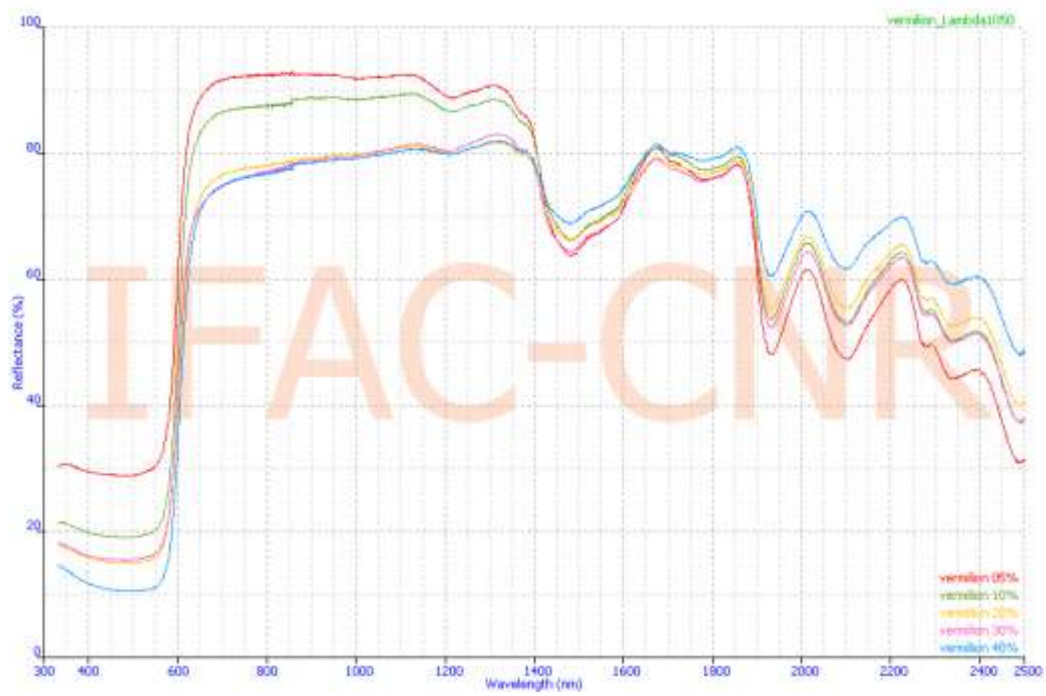


Figure VI.4.28. Reflectance spectra of Vermilion watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Cadmium red

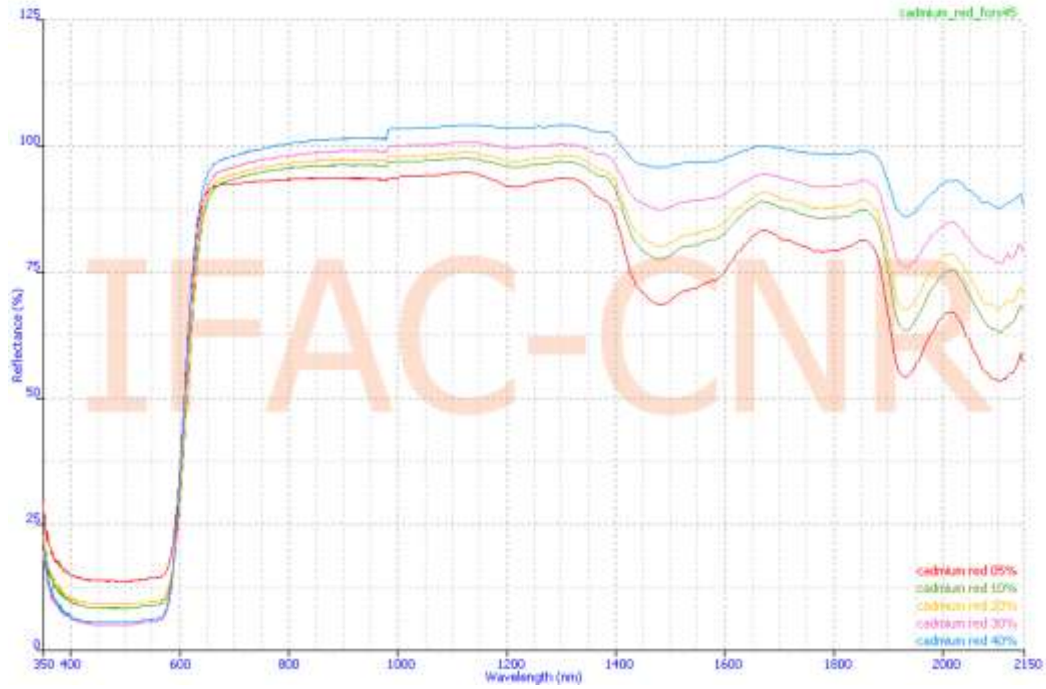


Figure VI.4.29. Reflectance spectra of Cadmium red watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

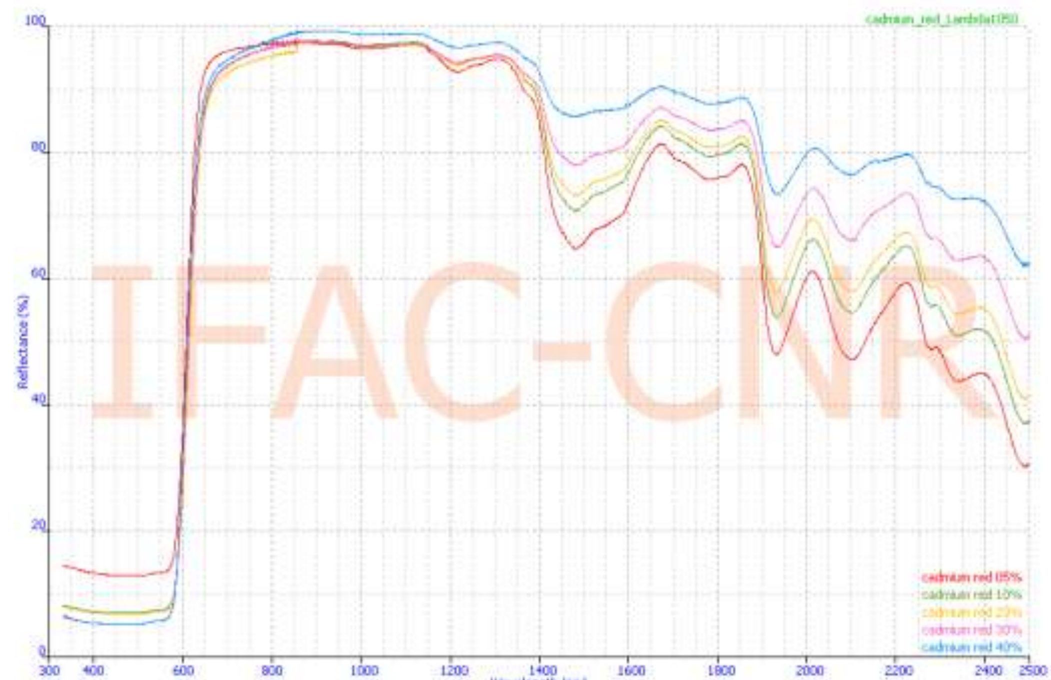


Figure VI.4.30. Reflectance spectra of Cadmium red watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Cadmium orange deep

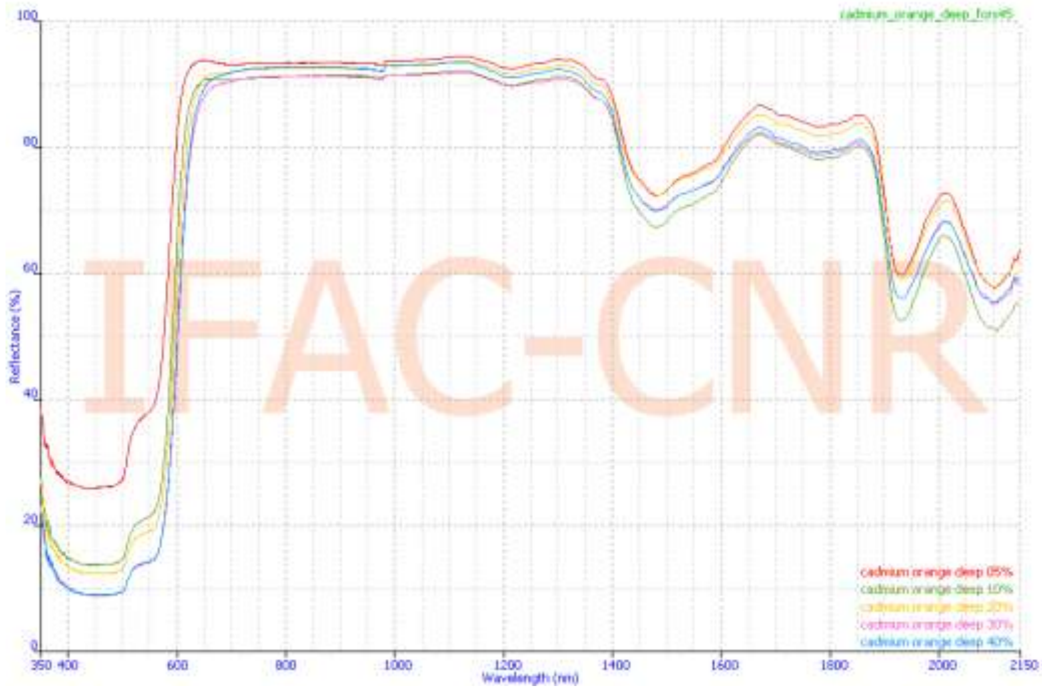


Figure VI.4.31. Reflectance spectra of Cadmium orange deep watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

Figure VI.4.32. Reflectance spectra of Cadmium orange deep watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

.

- Cadmium orange light

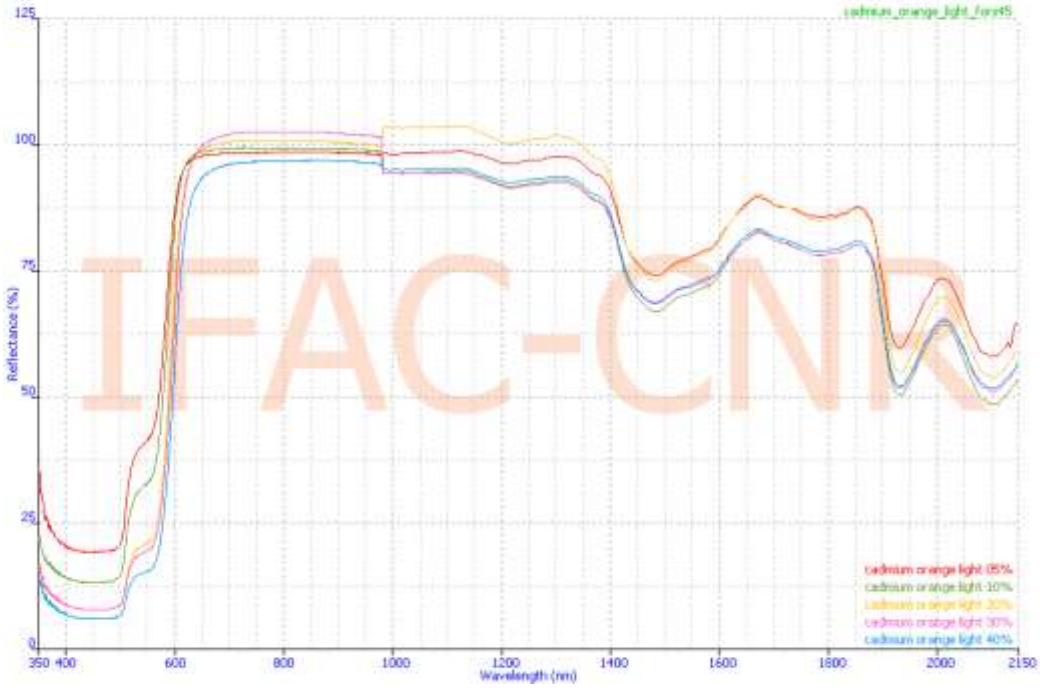


Figure VI.4.33. Reflectance spectra of Cadmium orange light watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

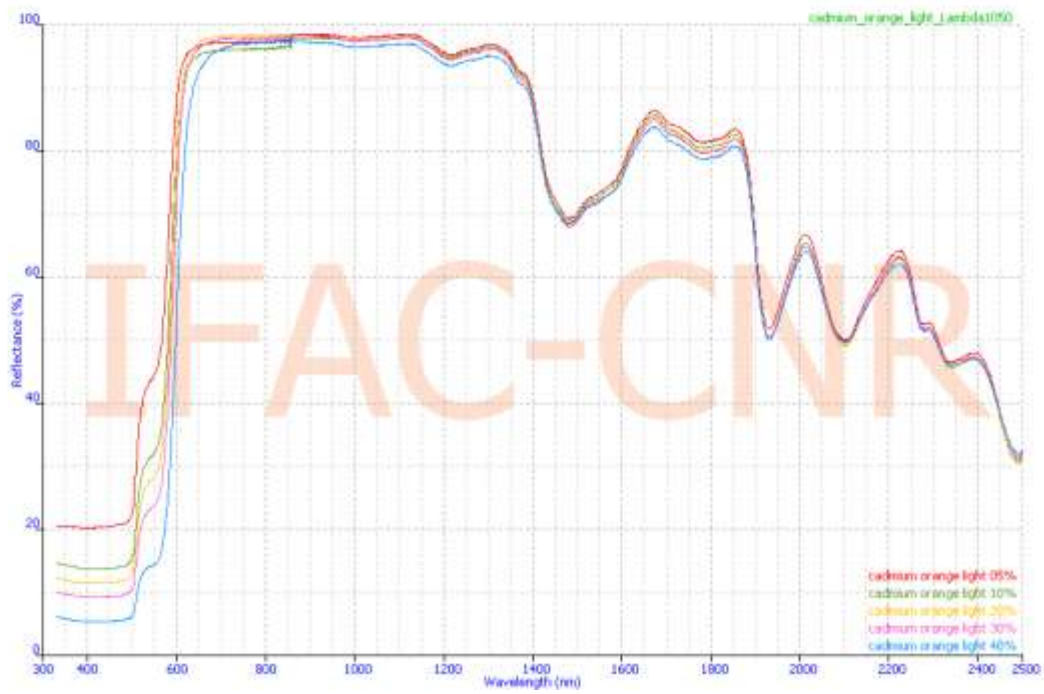


Figure VI.4.34. Reflectance spectra of Cadmium orange light watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Cadmium yellow

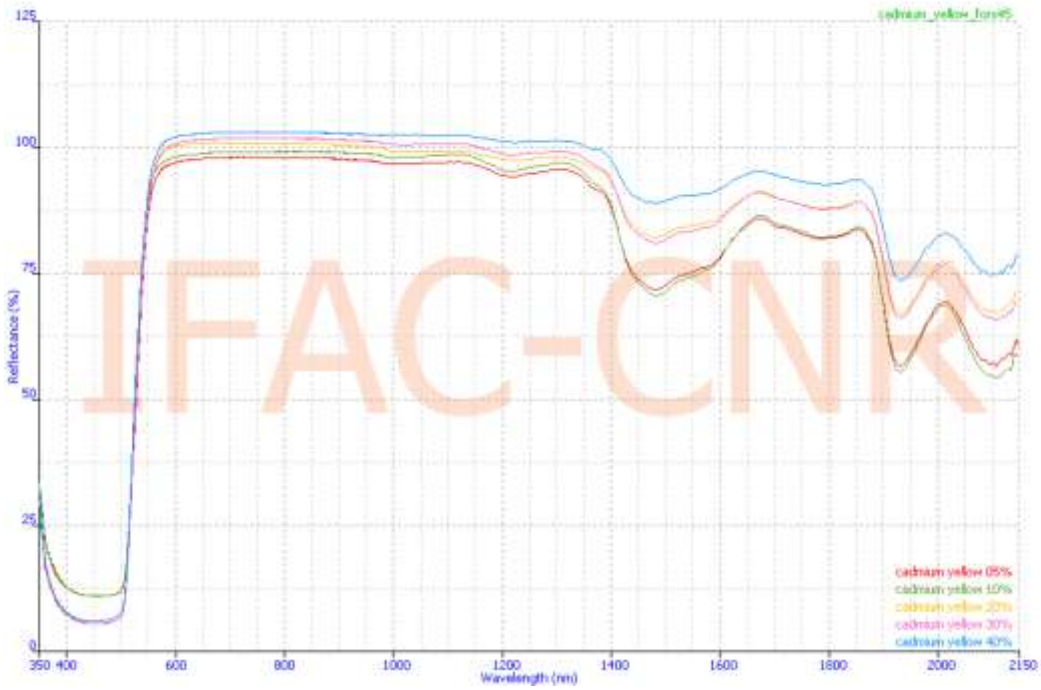


Figure VI.4.35. Reflectance spectra of Cadmium yellow watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

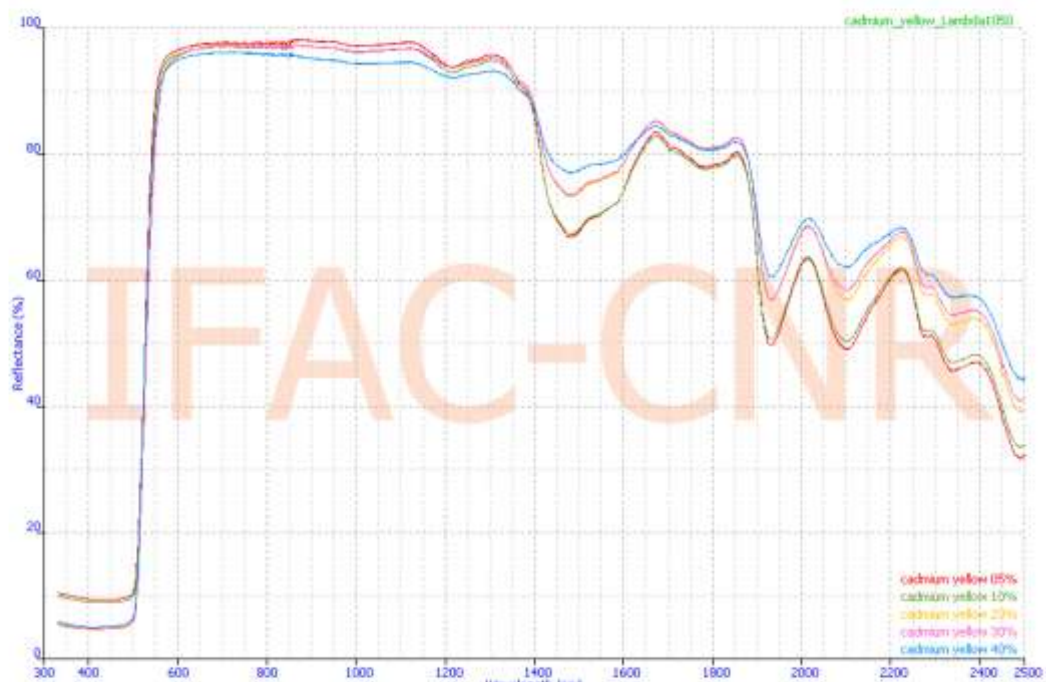


Figure VI.4.36. Reflectance spectra of Cadmium yellow watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Chrome yellow

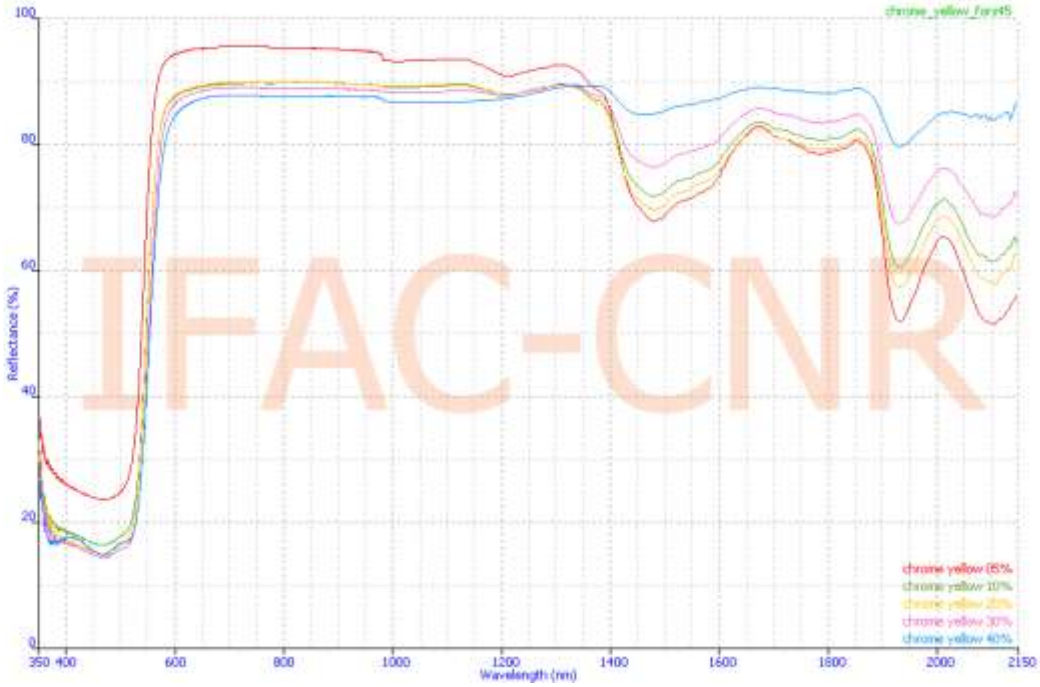


Figure VI.4.37. Reflectance spectra of Chrome yellow watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

Figure VI.4.38. Reflectance spectra of Chrome yellow watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Naples yellow

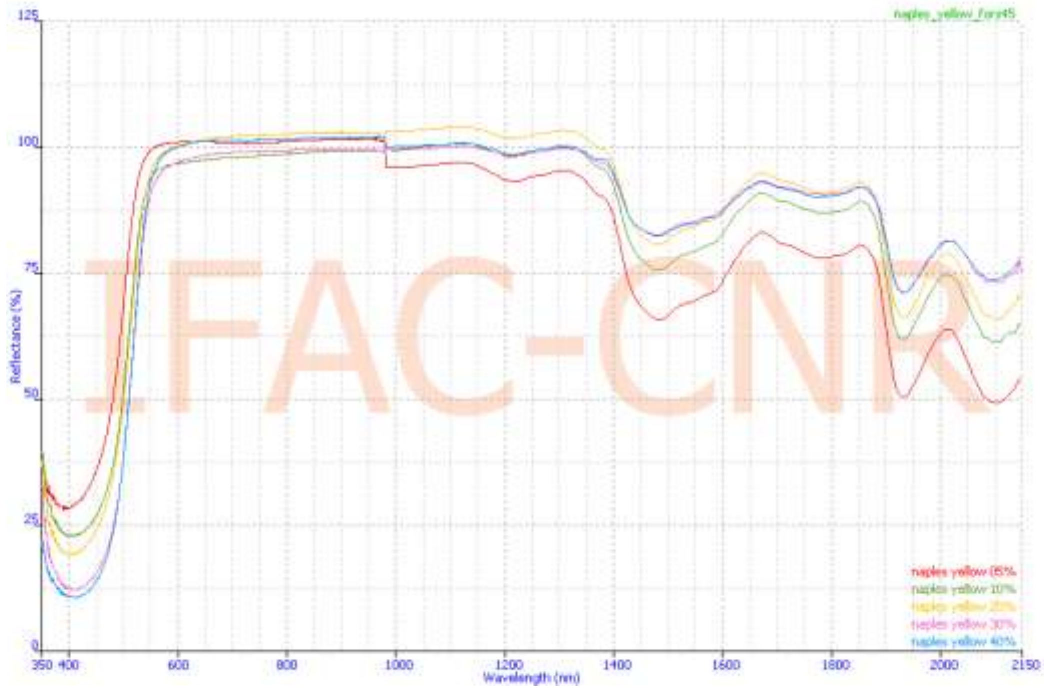


Figure VI.4.39. Reflectance spectra of Naples yellow watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

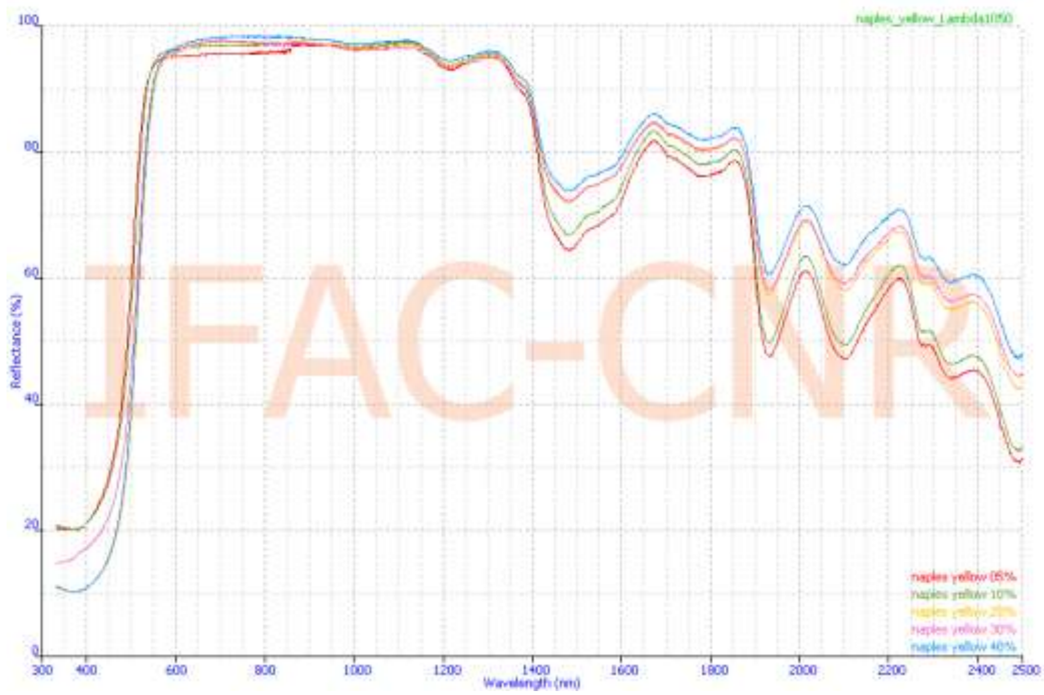


Figure VI.4.40. Reflectance spectra of Naples yellow watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Yellow ochre

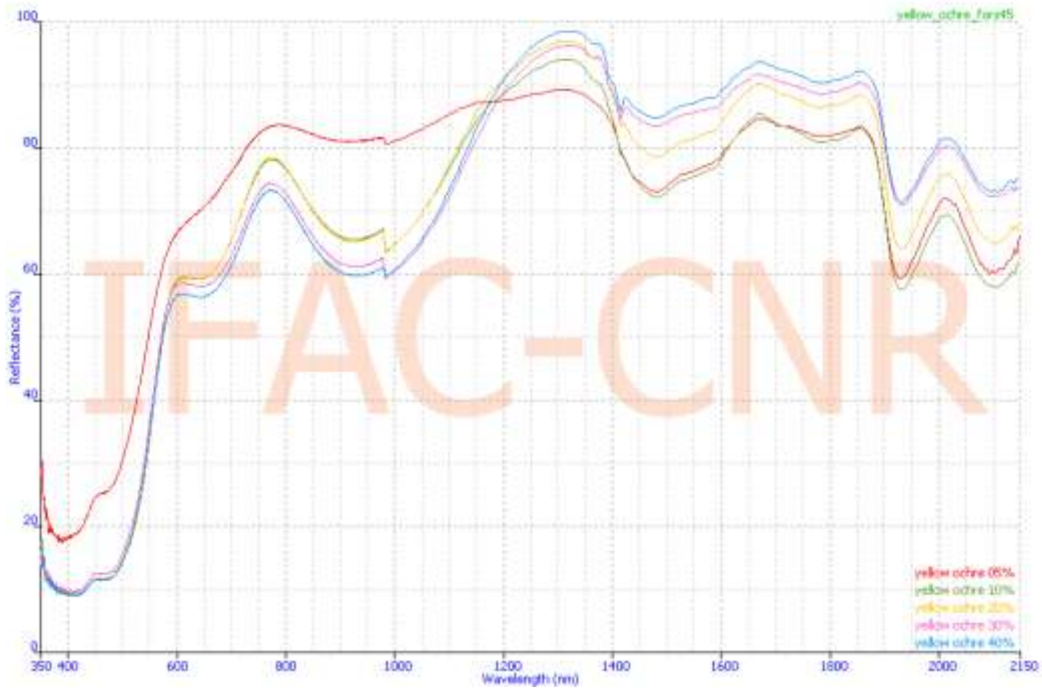


Figure VI.4.41. Reflectance spectra of Yellow ochre watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

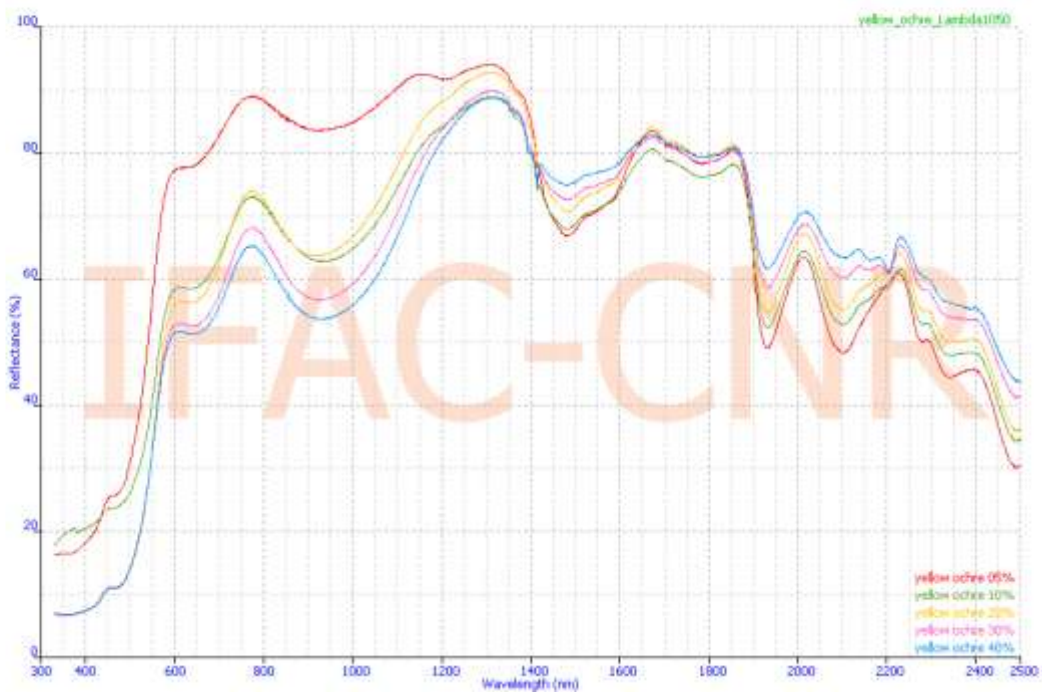


Figure VI.4.42. Reflectance spectra of Yellow ochre watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Raw Sienna

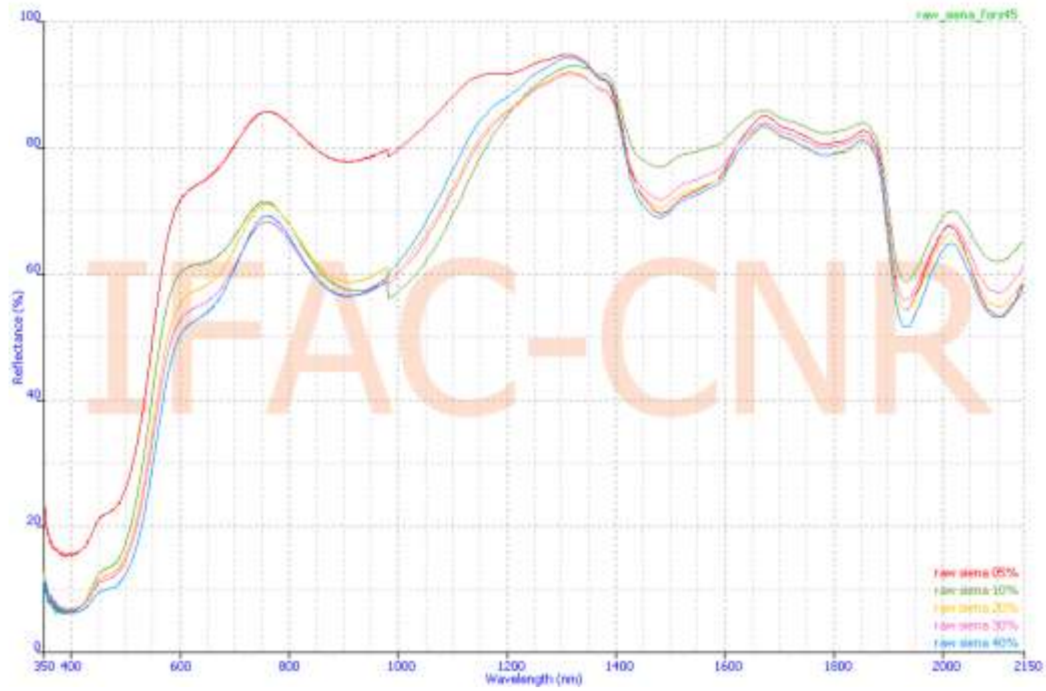


Figure VI.4.43. Reflectance spectra of Raw sienna watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

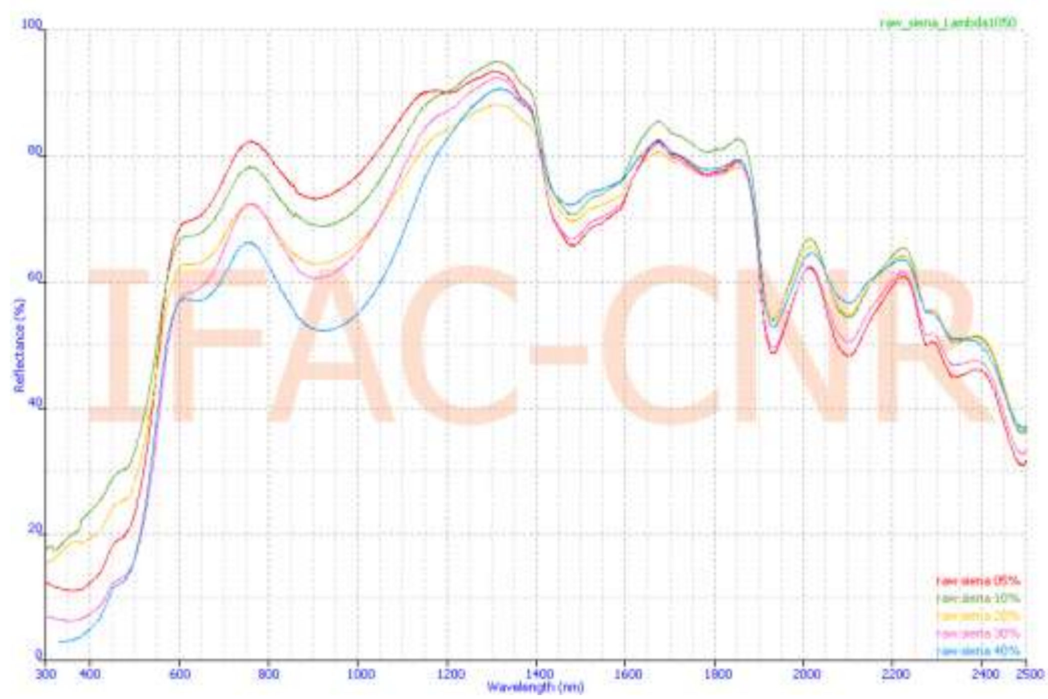


Figure VI.4.44. Reflectance spectra of Raw sienna watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Burnt Sienna

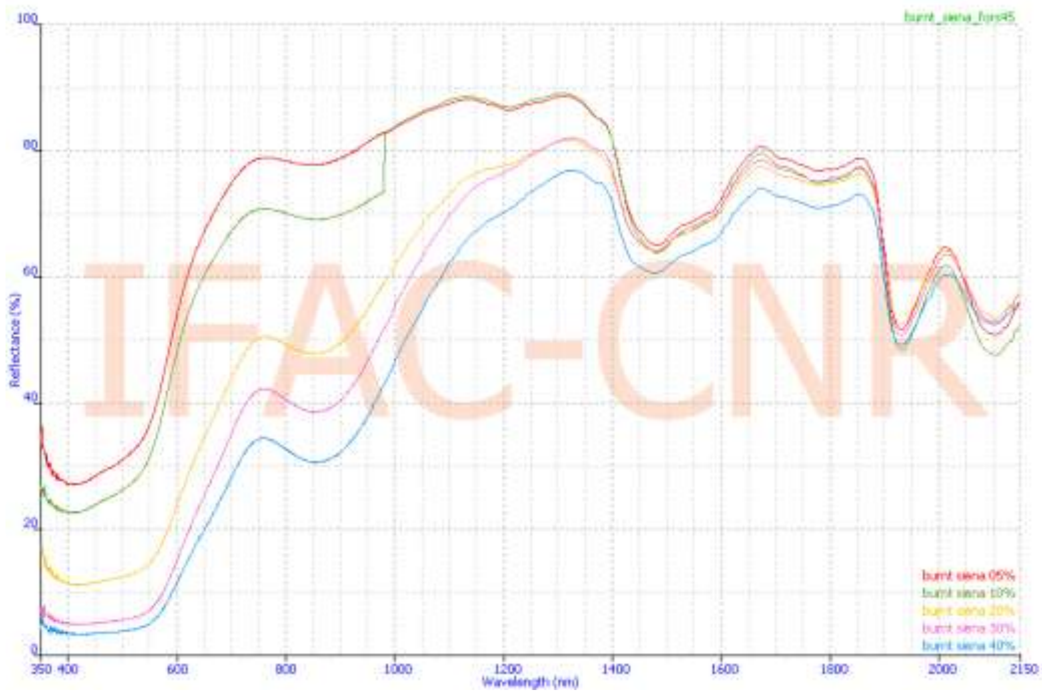


Figure VI.4.45. Reflectance spectra of Burnt sienna watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

Figure VI.4.46. Reflectance spectra of Burnt sienna watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Lead white

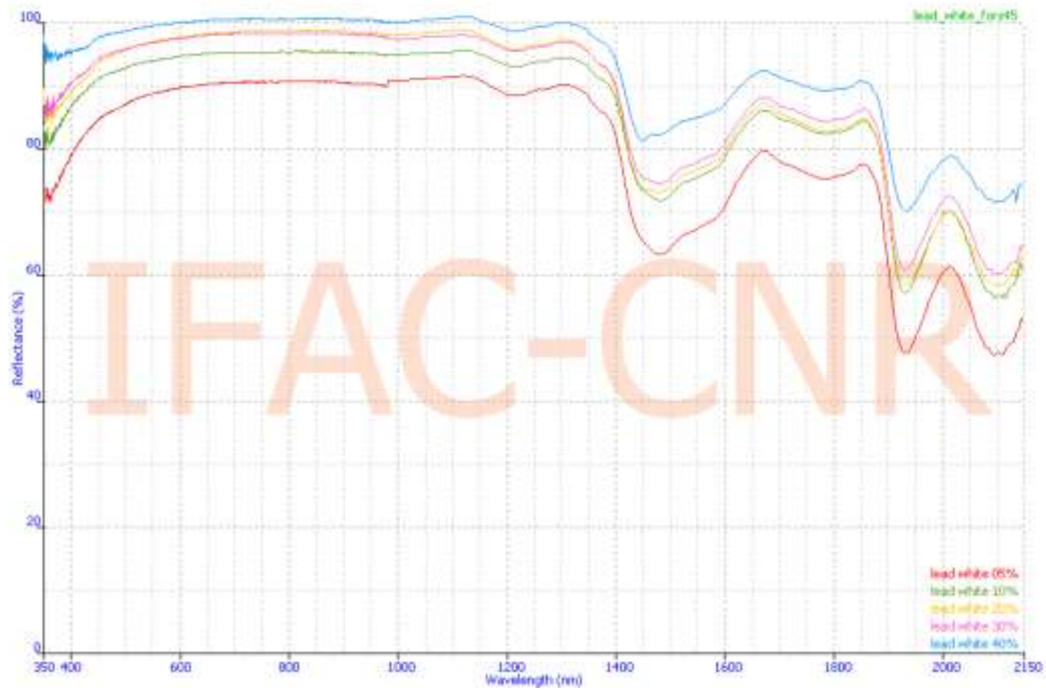


Figure VI.4.47. Reflectance spectra of Lead white watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

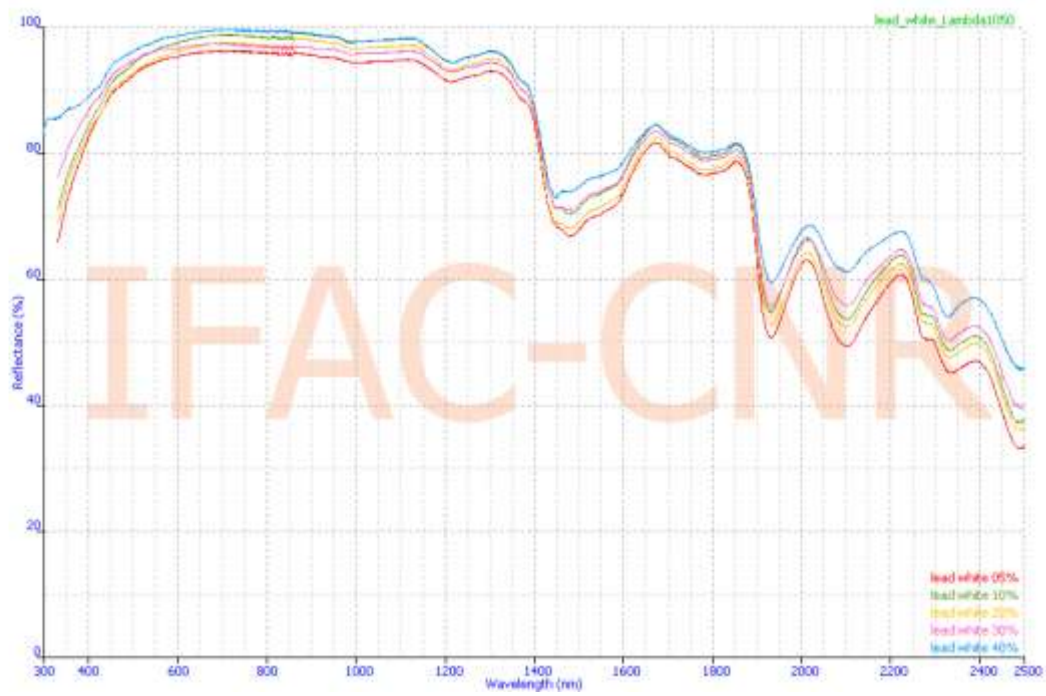


Figure VI.4.48. Reflectance spectra of Lead white watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Zinc white

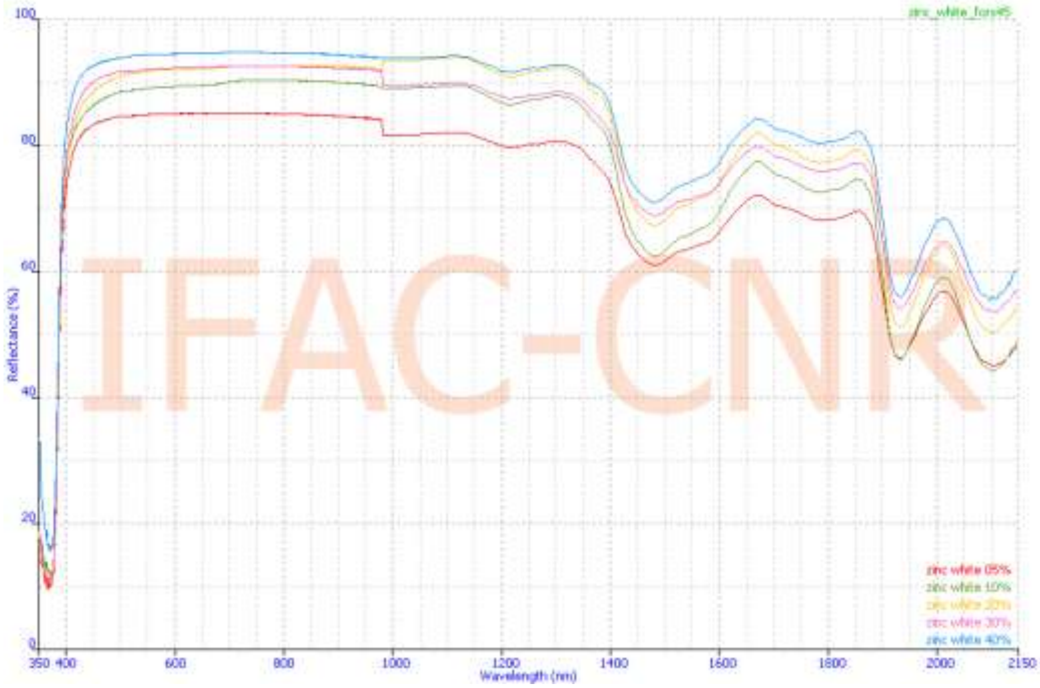


Figure VI.4.49. Reflectance spectra of Zinc white watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

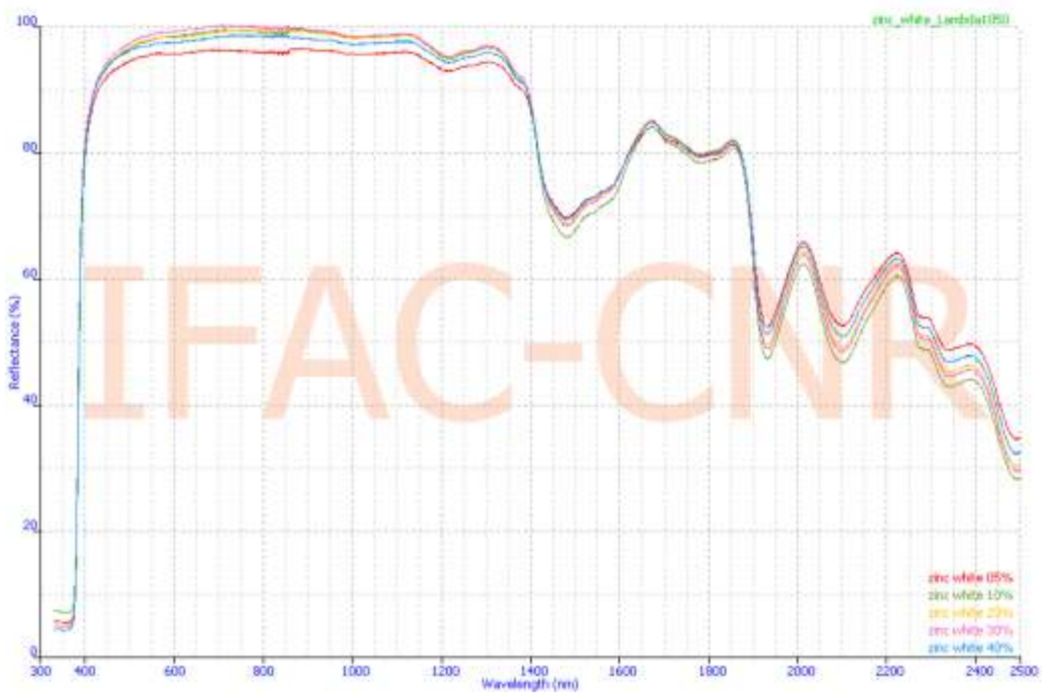


Figure VI.4.50. Reflectance spectra of Zinc white watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Barium sulphate

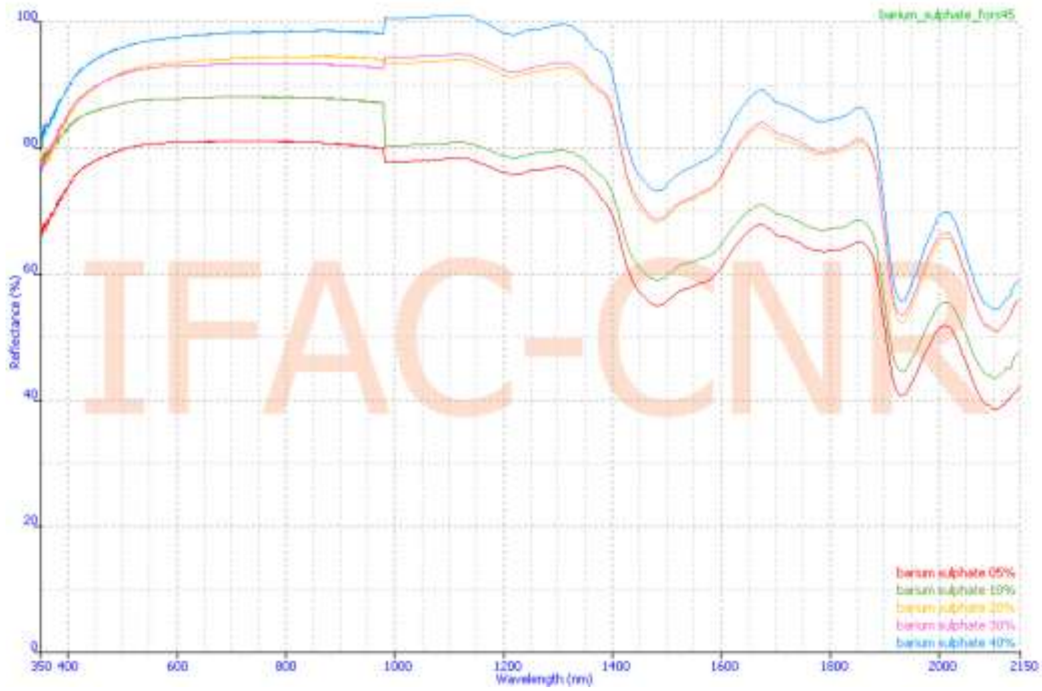


Figure VI.4.51. Reflectance spectra of Barium sulphate watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

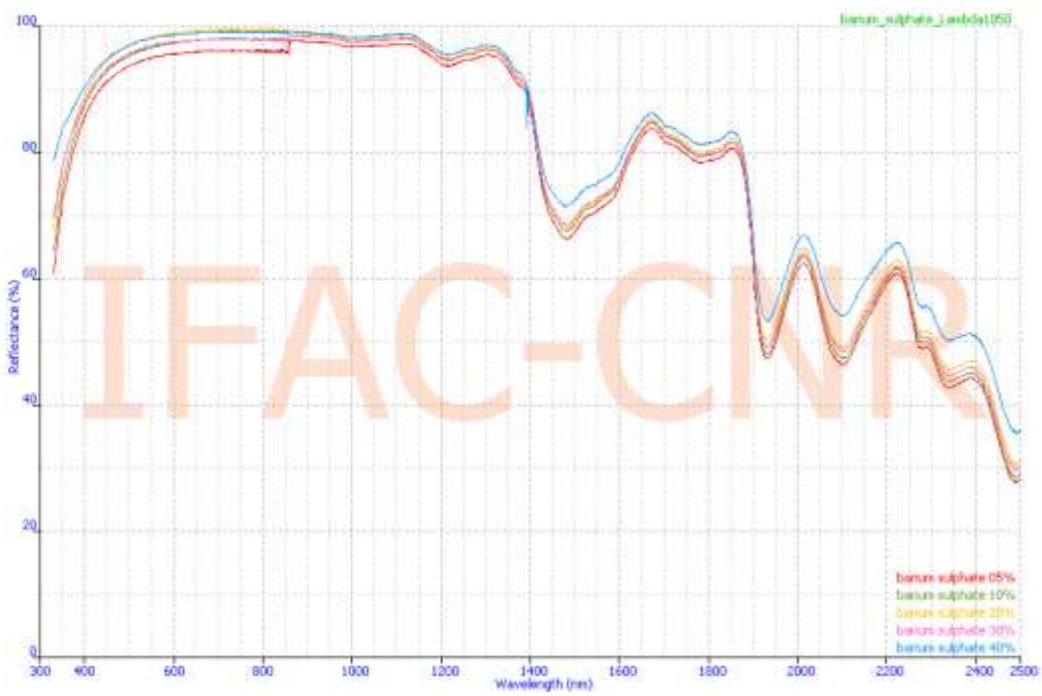


Figure VI.4.52. Reflectance spectra of Barium sulphate watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Lithopone

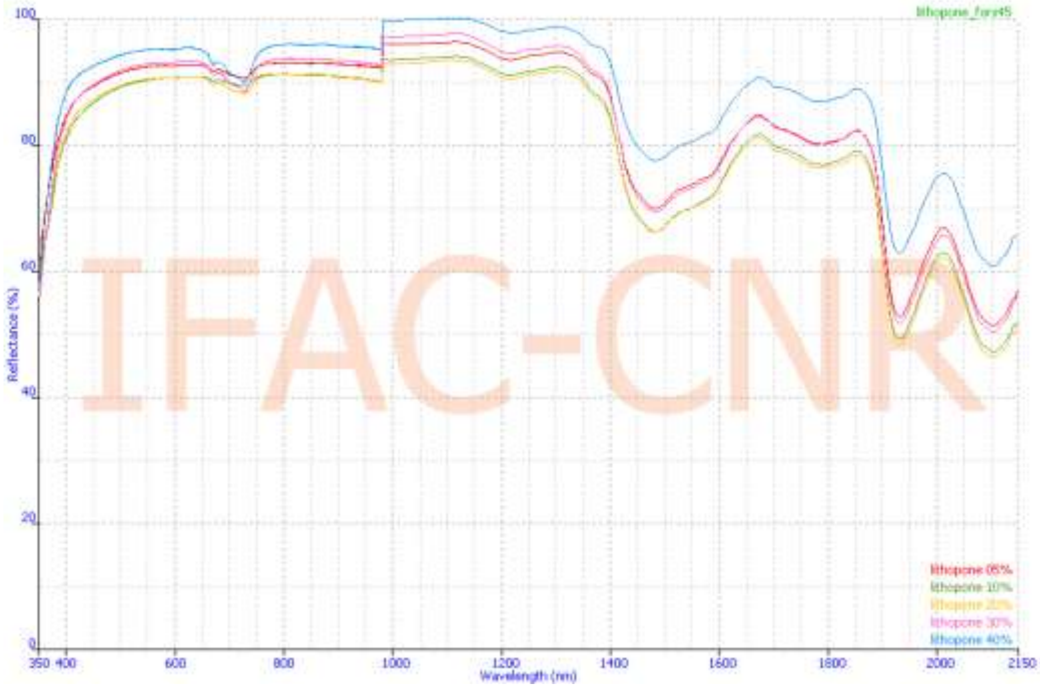


Figure VI.4.53. Reflectance spectra of Lithopone watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

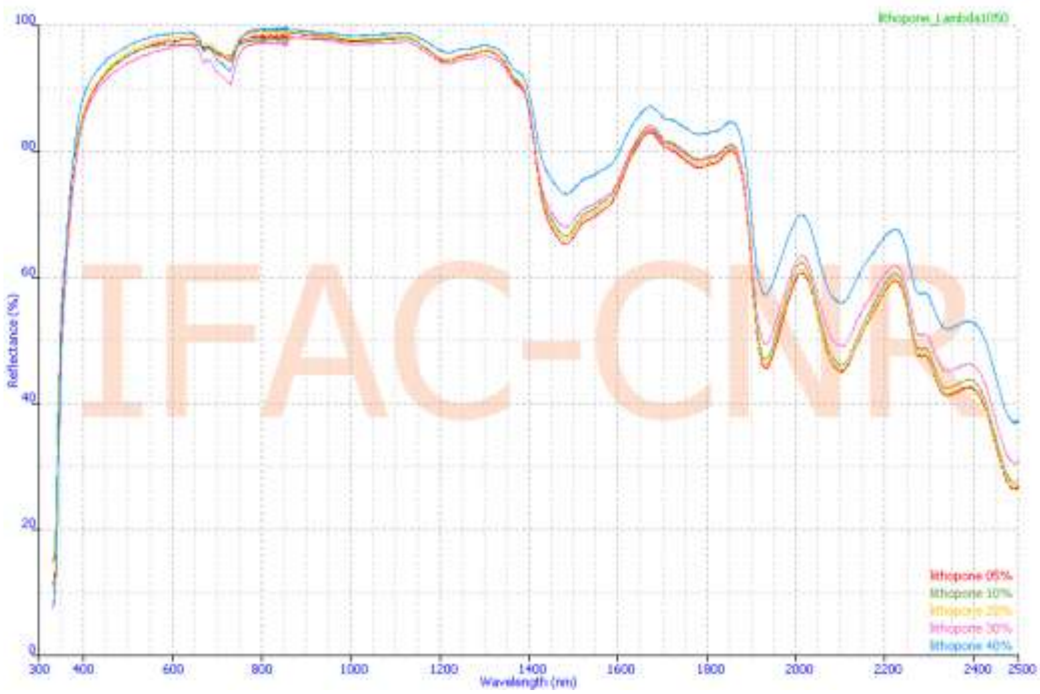


Figure VI.4.54. Reflectance spectra of Lithopone watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

• Graphite

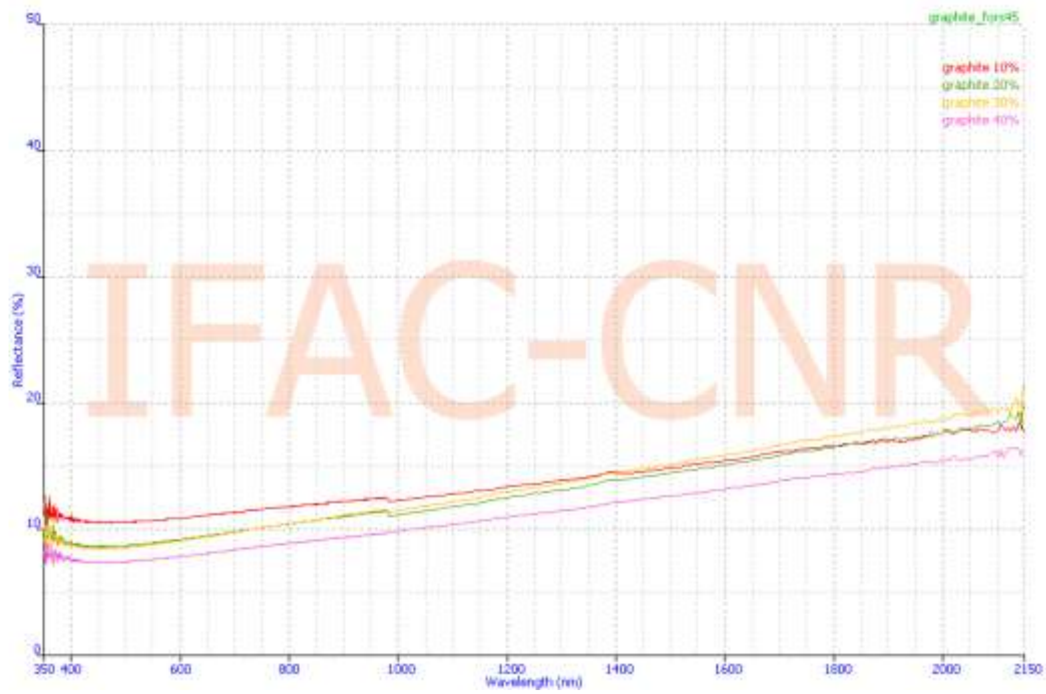


Figure VI.4.55. Reflectance spectra of Graphite watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

Figure VI.4.56. Reflectance spectra of Graphite watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Ivory black

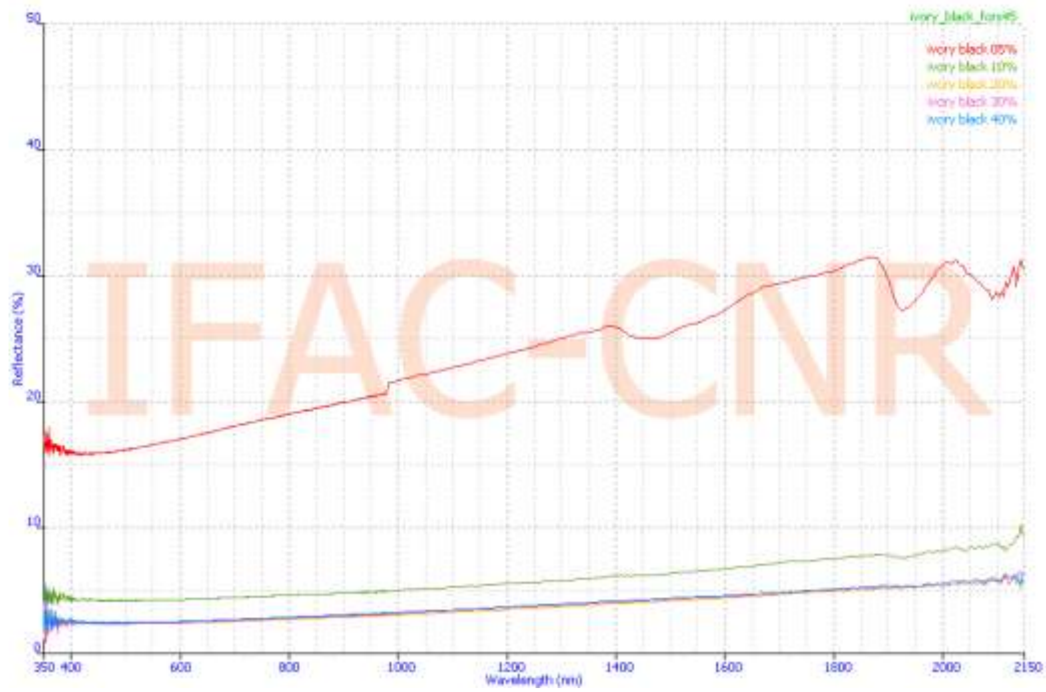


Figure VI.4.57. Reflectance spectra of Ivory black watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

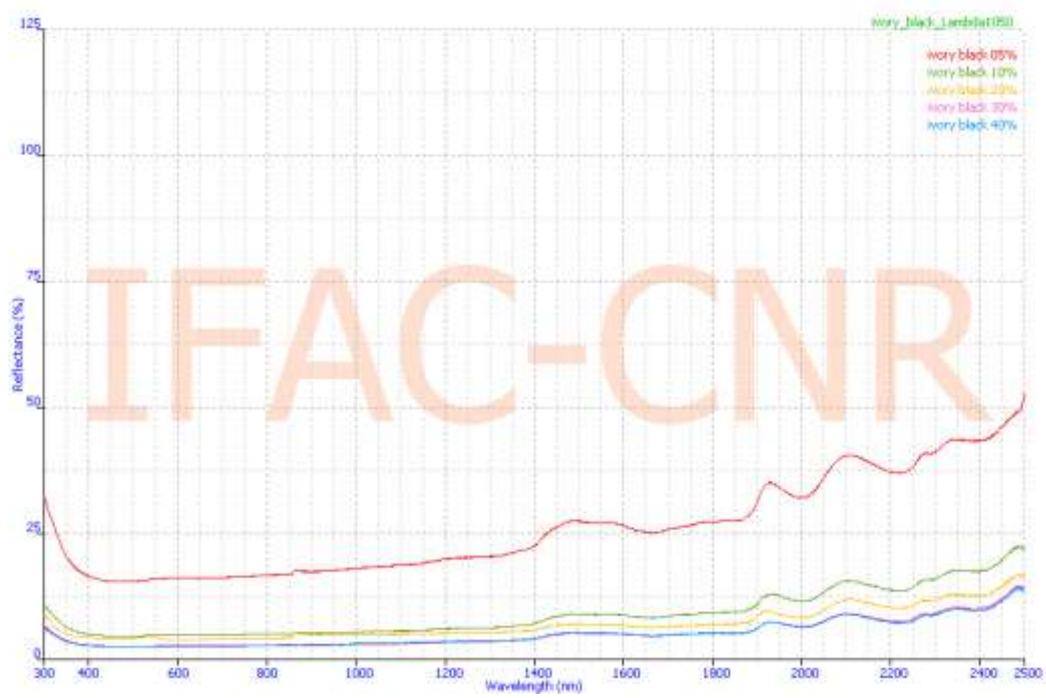


Figure VI.4.58. Reflectance spectra of Ivory black watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

- Vine black

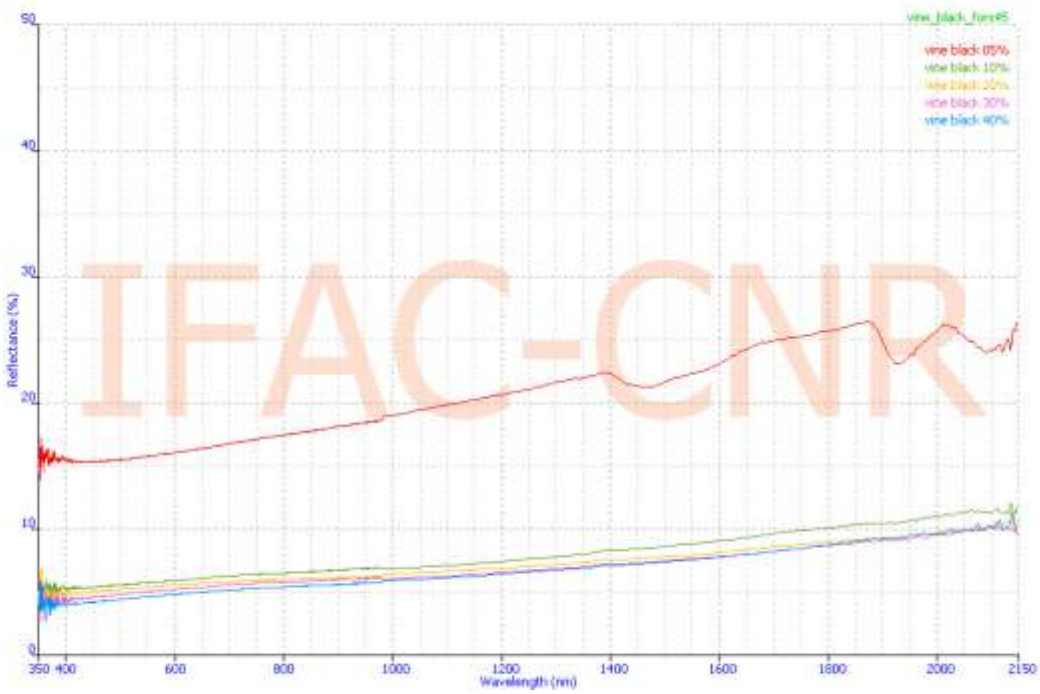


Figure VI.4.59. Reflectance spectra of Vine black watercolour paint (geometry of analysis: 0º/2x45º) [http://mowcres.ifac.cnr.it].

Figure VI.4.60. Reflectance spectra of Vine black watercolour paint (DRS Lambda 1050) [http://mowcres.ifac.cnr.it].

A6.5. – Application of Kubelka-Munk function

In ***Figure VI.5.1*** the absorption spectrum (40%) from the **cobalt violet (phosphate)** set of FORS spectra (8º/8º) is presented. In violet colour is shown the respective spectrum obtained from FORS device software (*Aspect Plus*). In black colour the result spectrum from its calculation from the Kubelka--Munk (KM) function (manualy) [*see* ***Chapter 5; section 5.2.2***] is presented for comparison. Both results are identical. For this reason, in this dissertation, all K-M function spectra presented result directly from the function transformation from FORS spectra to KM spectra through the device's software.

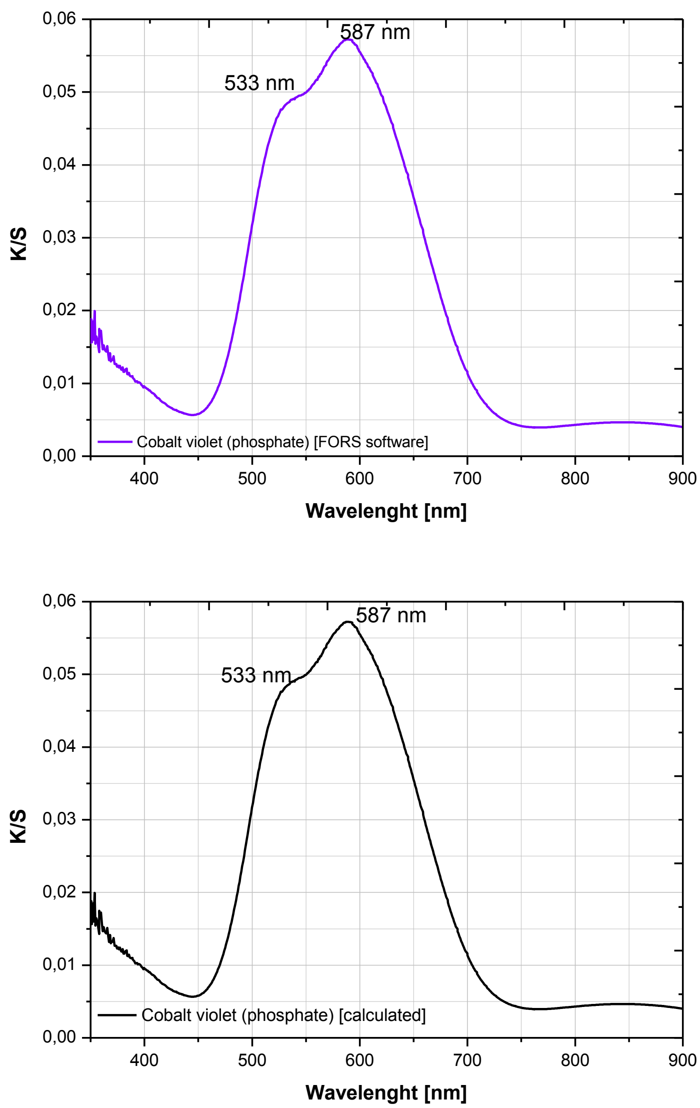
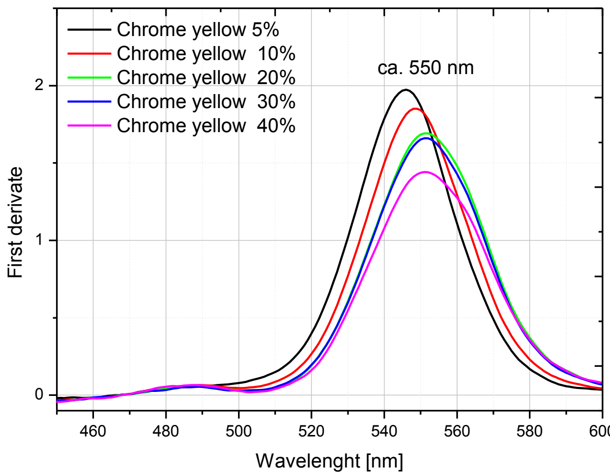


Figure VI.5.1. Kubelka-Munk function spectrum: *Above:* obtained from FORS device software; *Bellow:* obtained calculating manually.

A6.6 – Inflection points: first derivative (database)



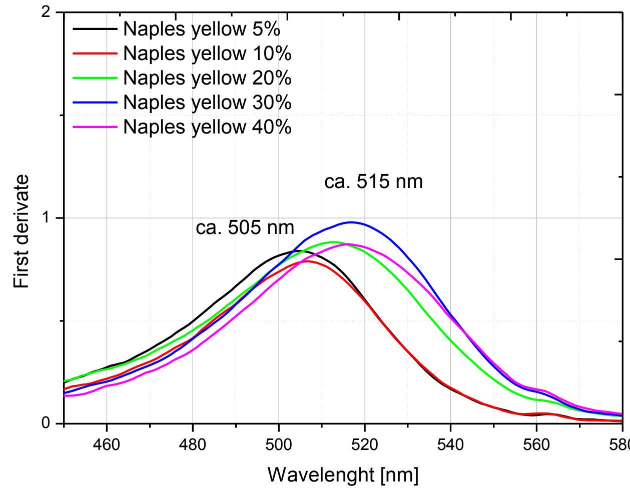
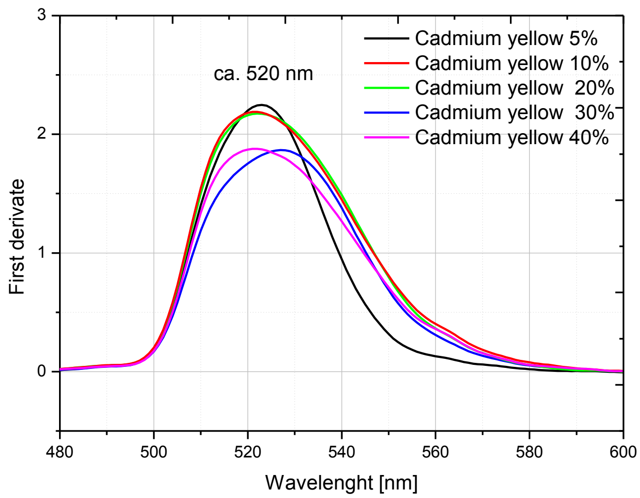


Figure VI-6.1. First derivate spectra: *On the left:* chrome yellow. *On the right:* Naples yellow.



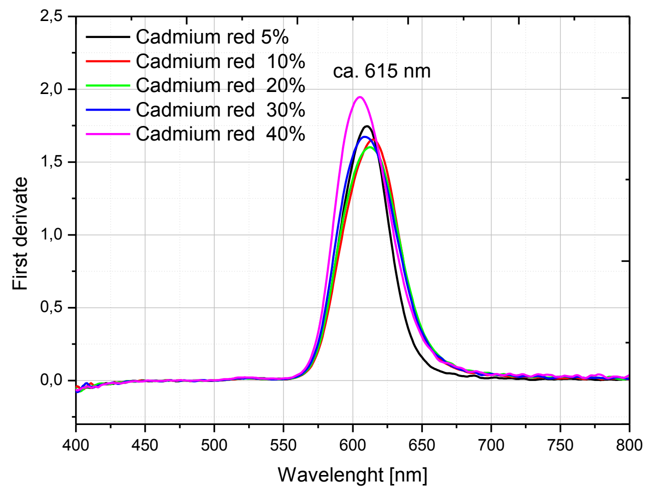
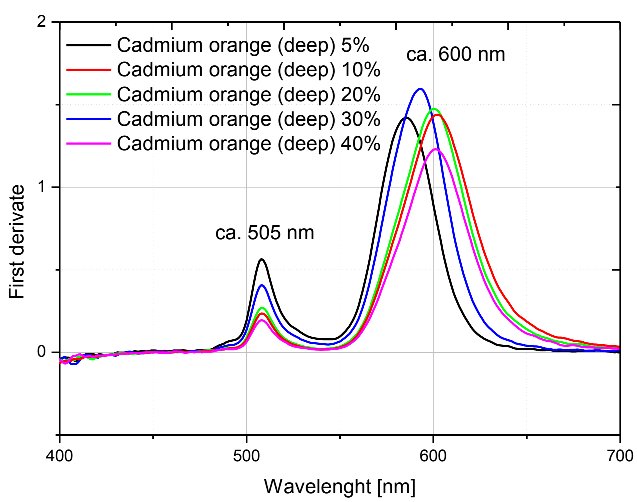


Figure VI-6.2. First derivate spectra: *On the left:* cadmium yellow. *On the right:* cadmium red.



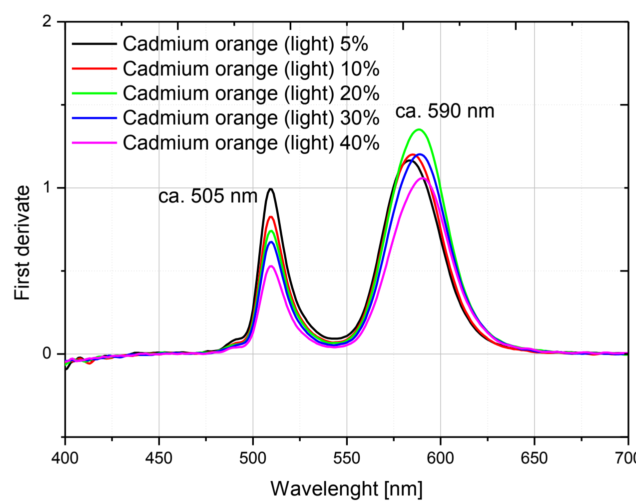


Figure VI-6.3. First derivate spectra: *On the left:* cadmium orange (deep). *On the right:* cadmium orange (light).

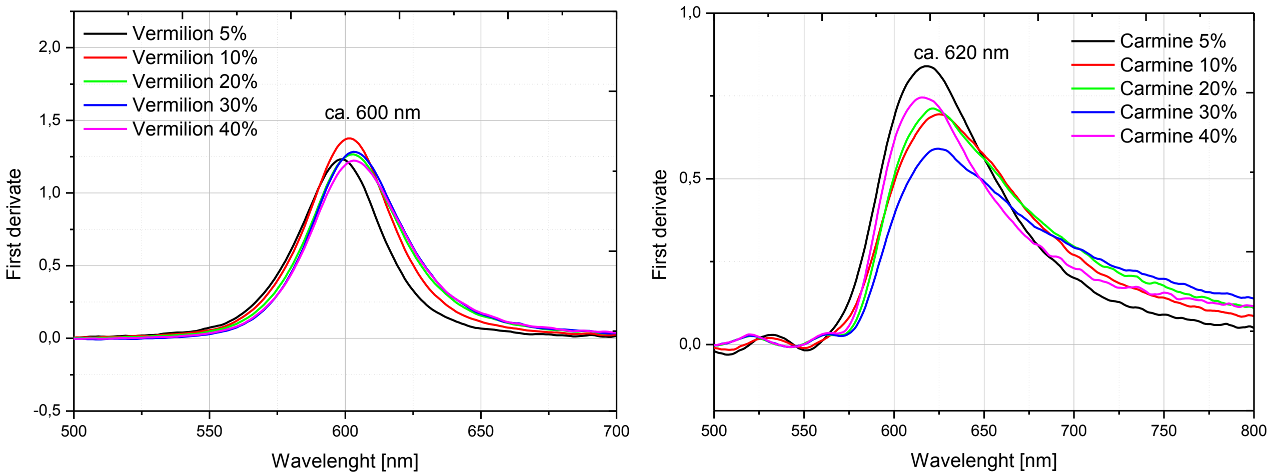


Figure VI-6.4. First derivate spectra: *On the left:* vermilion. *On the right:* carmine.

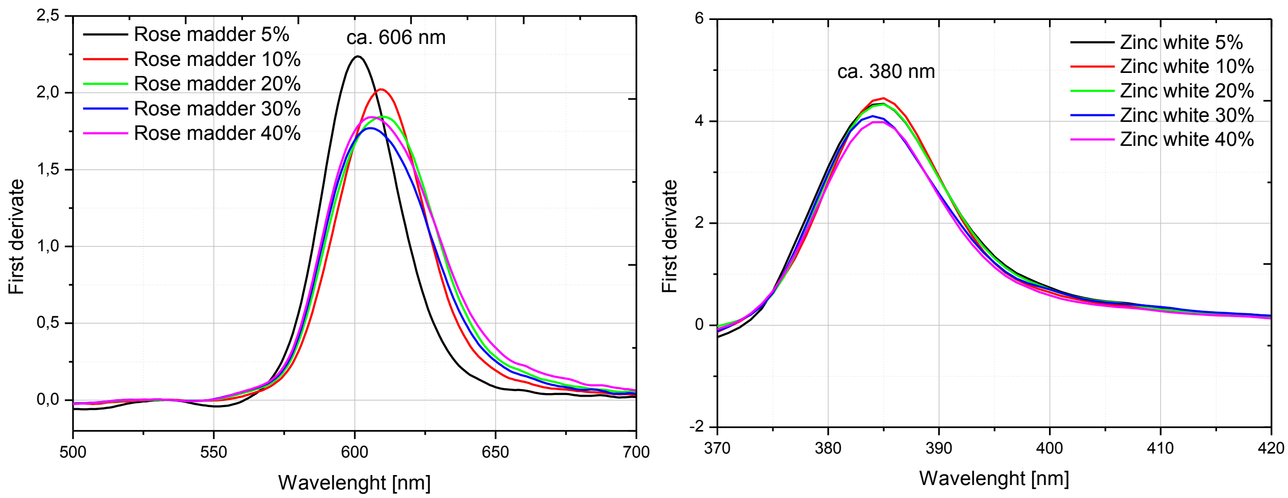


Figure VI-6.5. First derivate spectra: *On the left:* rose madder. *On the right:* zinc white.